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INVESTIGATION OF TRITIUM IN SURFACE SOILS AND PAVING MATERIALS SURROUNDING BUILDING 816 WORK PLAN

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ABBREVIATIONS AND ACRONYMS

A/C	-	Asphaltic concrete
CLEAN	-	Comprehensive Long-Term Environmental Action Navy
CLP	-	Contract Laboratory Program
CTO	-	Contract Task Order
DHS	-	California Department of Health Services
DNA	-	Deoxyribonucleic acid
DQO	-	Data Quality Objectives
EIC	-	Navy Engineer-in-Charge
EPA	-	U.S. Environmental Protection Agency
FSP	-	Field Sampling Plan
HPA	-	Naval Station Treasure Island, Hunters Point Annex
LSC	-	Liquid Scintillation Counter
HSP	-	Health and safety plan
MDA	-	Minimum Detectable Activity
MS/MSD	-	Matrix Spike/ Matrix Spike Duplicate
MeV	-	Million electron volts
NAI	-	Normandeau Associates Inc.
NRDL	-	Naval Radiological Defense Laboratory
NRC	-	Nuclear Regulatory Commission
PARCC	-	Precision, Accuracy, Representativeness, Completeness, and Comparability
pCi/g	-	Picocuries per gram
PRC	-	PRC Environmental Management, Inc.
QA	-	Quality assurance
QAPjP	-	Quality assurance project plan
QC	-	Quality control
RASO	-	Naval Radiation Affairs Support Office
RPD	-	Relative percent difference
SAP	-	Sampling and Analysis Plan
SD	-	Standard deviation
SDG	-	Sample Delivery Group
SO	-	Safety Officer
TMA/Norcal	-	Thermo Analytical/Norcal
WESTDIV	-	Naval Facilities Engineering Command, Western Division

$^{2}_{1}H$	-	Deuteron
$^{1}_{0}n$	-	Neutron
^{1}H	-	Hydrogen
^{3}H	-	Tritium
^{4}He	-	Helium

1.0 INTRODUCTION

PRC Environmental Management, Inc. (PRC), received Contract Task Order (CTO) No. 0155 from the Naval Facilities Engineering Command, Western Division (WESTDIV) to develop and implement Phase I Radiation Investigation, testing ambient air for radioactive particulates, and investigating the background levels of alpha, beta, and gamma radiation at Naval Station Treasure Island, Hunters Point Annex (HPA). This sampling and analysis work plan addresses one task of Phase II, Radiation Investigation under CTO 0155. Scope of Phase II work includes the evaluation of former Naval Radiological Defense Laboratory (NRDL) sites. Included in the list of former NRDL sites to be investigated is Building 816 which is PA-41 of the HPA PA/SI program. Tritium contamination in soil, asphaltic concrete (A/C), and concrete will be evaluated at PA-41 following this work plan.

This work plan presents PRC's approach to evaluating tritium in surface soils and paving materials surrounding Building 816. In the past, the building contained a van de Graaff generator that was to be used as an electron and ion accelerator; the building also housed a radiochemistry laboratory. The location of Building 816 is shown on Figure 1.

1.1 BACKGROUND

Personal communication from Filbert Fong, a former NRDL employee who now works for the State of California, Department of Health Services (DHS), stated that Building 816 was contaminated with tritium and was subsequently decontaminated. There are no data currently available, however, that documents actual tritium contamination at the site. Tritium (^3H) is a radioactive, beta-emitting isotope of hydrogen (^1H). This radioisotope has a physical half-life of approximately 12.3 years.

To evaluate the potential for human exposure through contact, inhalation, or ingestion of tritium, soils and paving materials will be sampled and analyzed for tritium content. Although tritium is radioactive, it reacts chemically as if it were hydrogen. If ingested, tritium combines with free hydroxyl groups within the body to form tritiated water. In this form, tritium is chemically identical

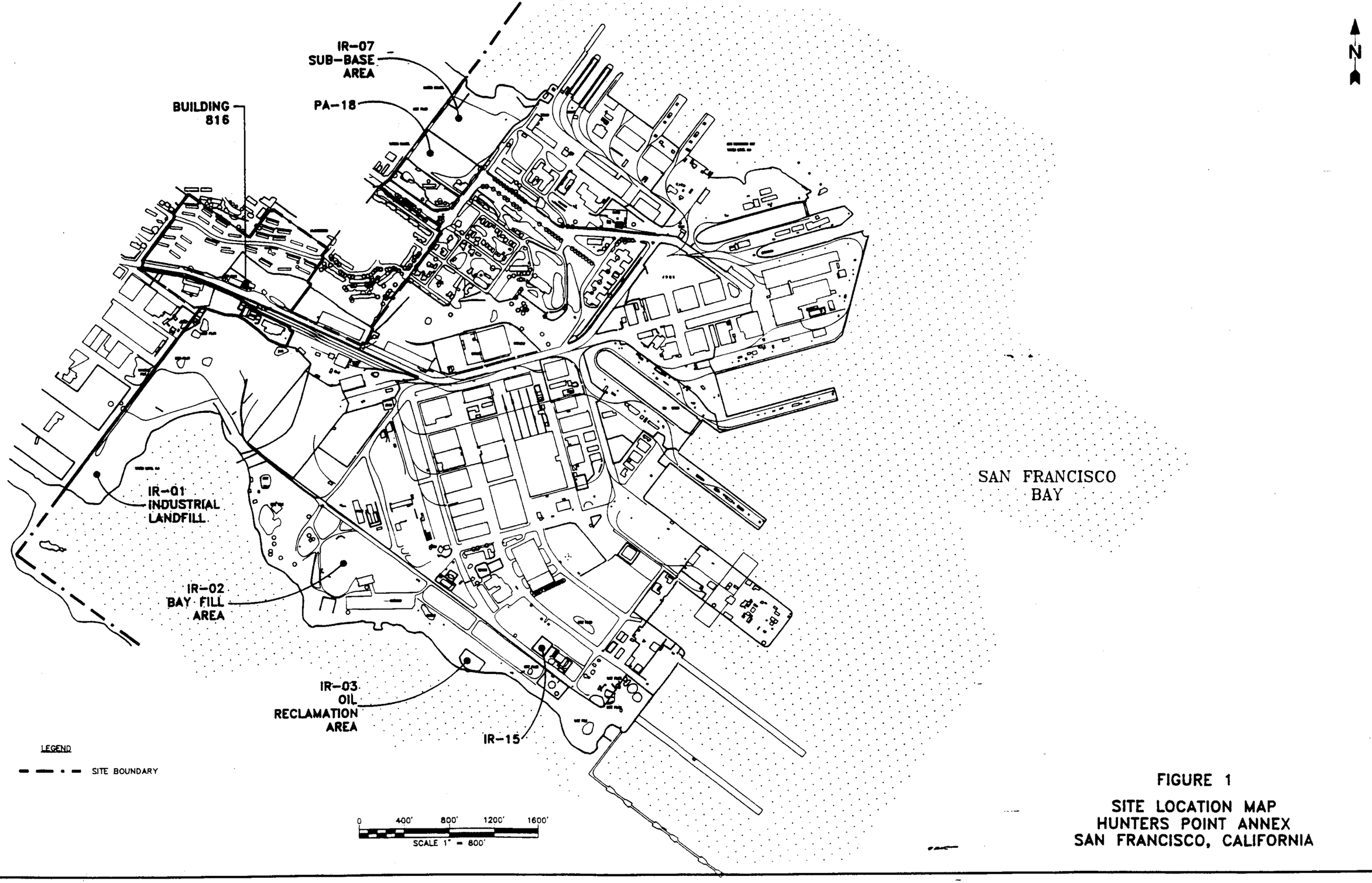

FIGURE 1

SITE LOCATION MAP
HUNTERS POINT ANNEX
SAN FRANCISCO, CALIFORNIA

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to normal water and is distributed uniformly throughout the body, and is readily excreted in sweat, urine, and feces. Because of this, the biological half life of tritium is considered to be approximately 10 days. Beta particles that are emitted from tritium are of low energy. Due to these characteristics, the Annual Limit on Intake, established by the Nuclear Regulatory Commission (NRC), for ingestion of tritium is approximately 80,000 microcuries (μCi) per year.

In 1978, Navy personnel from the Naval Ocean Systems Center, San Diego, and the Naval Nuclear Power Unit, Port Hueneme, California, performed a cursory radiation survey of potentially contaminated facilities formerly occupied by NRDL, which included Building 816. The Navy survey team acknowledged that the building had a history of tritium use, but was unable to survey for tritium because the radiation survey equipment that they used was not designed to detect low-energy beta emissions produced by tritium. They recommended that an appropriate resurvey of the interior building surfaces be performed to screen for tritium.

In 1979, a smear (wipe) survey was performed by the Naval Nuclear Power Unit at five locations within Building 816. The smears were analyzed for low-energy beta by the Naval Research Laboratory. Smears were collected from the Target Pit, Target Room, Magnet Room, Laboratory, and the Accelerator Room. Results of the survey indicated that surface radiation levels for fixed and removable contamination did not exceed U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.86 guidelines. The Navy recommended that the building and its environs be released for unrestricted occupancy and use. Although the environs of Building 816 were released by the Navy for unrestricted use, a survey for tritium was not performed outside the building. Therefore, soils, concrete, and asphaltic concrete that surround the building need to be evaluated for the presence of tritium.

There are four former potential sources of tritium that may have contributed to contamination of concrete surfaces within Building 816, and, theoretically, may have resulted in contamination outside of the building. These potential sources are: the tritium targets that were used with the van de Graaff generator; tritiated water that may have been produced within the van de Graaff generator's water-filled, target cooling bath; tritium that may have been released from vacuum pump oil; and tritiated thymidine used in the laboratory.

A van de Graaff generator of the type that may have been used in Building 816 was capable of establishing electrostatic potentials of several hundred thousand electron volts. Electrostatic potential is used to accelerate electrons, ions and other charged particles to high velocities. An accelerated beam of deuterons ($^{2}_{1}H$) when focused on tritium-containing targets causes neutron emissions. Deuterons are positively charged particles consisting of a proton and a neutron. A neutron is a subatomic particle of unit mass and no charge. The interaction between the deuterons and tritium causes neutrons to be emitted according to the reaction: $^{3}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n + 18$ MeV. The neutrons produced can then used to activate metals (cause to be radioactive) to determine the effects of activation upon metal structure and to identify the resulting activation products by using radiation detection methods.

The second potential source of tritium is tritiated water, ($^{3}_{1}H_{2}O$) which can be a radioactive product incidental to the production of neutrons after they are passed through water. To prevent the deuteron-bombarded, tritium-containing targets from burning up, the targets are immersed in a non-recirculating, water-filled cooling bath. Water present in the target cooling bath may become radioactive if a sufficient neutron flux rate is achieved. Mr. Filbert Fong has stated that the water was periodically sampled and analyzed for tritium and that no tritium was detected. Nonetheless, it is possible that during operation of the van de Graaff generator, tritiated water may have been unintentionally released by evaporation into indoor air of Building 816. It is alleged that when tritium targets were bombarded with deuterons, concrete walls and surfaces inside the facility were possibly contaminated with tritium.

Mr. Fong has suggested that the third and most plausible mechanism resulting in tritium contamination inside Building 816 may be attributed to the release of tritium from oil that was used in vacuum pumps associated with the operation of the van de Graaff generator. Oil-filled vacuum pumps are used in applications where it is critical to reduce the atmospheric pressure inside closed vessels to very low levels. To maintain a high vacuum there must not be leaks within the evacuated system. Even if no other system leaks are present, the pump may be considered to be an inherent leak source since there is not a perfect seal between the vacuum piston, its rings, and the cylinder wall. The oil that is used in an oil-filled vacuum pump increases the pressure on the seal between the rings and the cylinder wall, and reduces the system pressure loss.

The air inside the van de Graaff accelerator tube housing was removed with a vacuum pump of this type to reduce the interaction between accelerated deuterons with air molecules. Tritium released from the bombardment of tritium targets would have volatilized inside the accelerator tube. Because the accelerator tube system had free tritium gas within its low-pressure atmosphere, tritium would have been brought into contact with the oil on the vacuum pump cylinder walls, thus contaminating it.

The fourth possible source of tritium contamination at Building 816 may be due to accidental spillage of a tritiated nucleotide: thymidine. A former NRDL technician interviewed by Navy Radiological Affairs Support Office (RASO), who worked at Building 816, revealed that tritiated thymidine may have been used at the site and that spills may have occurred. Mr. Fong has stated that he believes that less than one curie of tritiated thymidine was used over a period of one year in Building 816. Although it is reasonable to assume that the chemical breakdown of this nucleotide should have occurred during the past 25 years since it was used, the tritium component may still be detectable if a spill was not decontaminated after it occurred.

Radioactive and non-radioactive nucleotides are chemically identical and are interchangeably incorporated into Deoxyribonucleic Acid (DNA). In the laboratory, the substitution of a radioactive analog into a nucleotide sequence assists in the identification of specific DNA segments of biochemical interest. In the environment, tritiated thymidine may potentially be introduced into genetic material. If tritiated thymidine is present outside Building 816, it can be easily incorporated into the DNA of biological receptors.

Tritium contamination inside Building 816 was reported by DHS to have been removed by steam cleaning concrete surfaces. Contaminated waste water that was generated during decontamination was believed to have been collected and disposed off-site. As indicated above, the wipe survey performed in 1979 by the Naval Nuclear Power Unit indicated that no tritium contamination was found inside the building; however, a survey for tritium of the exterior soils and pavement was not performed. DHS is concerned that NRDL personnel may have walked through tritium-containing waste water inside the building and transferred some of the contaminated water from their shoes to surfaces outside the building. Therefore, soils, concrete, and asphaltic concrete that surround the building will be tested for the presence of tritium.

1.2 PURPOSE

The purpose of this sampling and analysis work plan is to provide the rationale and scope of field sampling, and to present sample handling protocol and the analytical methods that will be used for soil, A/C, and concrete sample testing at Building 816. The samples will be analyzed for tritium and results will be reported in picocuries per gram (pCi/g).

2.0 TECHNICAL APPROACH

2.1 TASK DESCRIPTIONS

This section provides a description of the tasks that will be performed during the investigation of tritium in soils and paving materials that surround Building 816.

2.1.1 Sampling Strategy

The sampling strategy was developed based upon the theory that tritium contamination originating inside Building 816 would be primarily found around doors and exits outside the building. Further, if tritium contamination had migrated outside, it may have been transferred by foot traffic to other locations around the exterior of the building. Therefore, areas around doors and exits, soil and paving materials immediately adjacent to walkways surrounding Building 816 were selected for sampling.

Surface samples of soil, concrete, and A/C will be collected around the perimeter of Building 816. Surface soils are defined as the first 6 inches of soil depth. A surface sample for A/C and concrete is defined as the first one-half inch of material. Thirty-one soil samples, six concrete samples, and fifteen A/C samples will be collected for tritium analysis.

Concrete and A/C samples that are taken immediately adjacent to the building foundation will be collected approximately 2 feet away from the building foundation. This sampling strategy is based upon the assumption that as people walk parallel to a wall on a narrow walkway, they tend to be about 2 feet from the wall. Exposed soil will be collected approximately 6 inches from walkways and

from the building foundation. This 6-inch sampling distance was selected for exposed soils around walkways and the building foundation based upon the assumption that water runoff will penetrate soil surfaces immediately adjacent from a walkway or paved areas.

At the time when tritium contamination may have occurred inside Building 816, the area surrounding the building may not have been paved. Currently, there is not sufficient information to establish when alleged episodes of tritium contamination occurred or when paving materials were placed around Building 816. Since there is a possibility that tritium may have been introduced into previously exposed soil in unpaved areas, soil that lies below concrete and A/C will also be tested for tritium. The paving material will be removed at each A/C and concrete sampling location to expose underlying soil for sampling. If several layers of paving material are encountered, each layer will also be sampled. All samples will be stored and shipped in accordance with the information provided in Appendix A.

As shown on Figure 2, the area surrounding Building 816 is divided into five general areas from which samples will be collected. On Figure 2, these areas are listed clockwise from the north corner of Building 816: the North Walkway Area, the East Asphaltic Concrete Area, the Southeast Soil Area, the South Entrance Area, and the West Asphaltic Concrete Walkway Area. Table 1 lists the type of sample matrix and number of samples to be collected from each area and the number of replicate analyses for each matrix. For each matrix, Table 2 shows the analysis to be performed, the number and type of sample containers to be used, sample preservation, and holding time information.

2.1.2 Soil Surface Sampling

Soil samples will be collected in accordance with the PRC's CLEAN Draft Ionizing Radiation Protection Program April 18, 1993 (in review), Sections 17.1.1 through 17.1.1.6. The applicable soil sampling protocol and sample handling procedures are provided in Appendix A. The samples will be placed in 200-ml screw top plastic jars and stored at 4°C prior to shipment to the laboratory.

B816SS01
B816AC01
B816SS31
B816AC15
B816AC02
B816SS02
NORTH WALKWAY AREA
NORTH EXIT
B816AC03
B816SS03
B816SS04
B816SS05
ASPHALTIC CONCRETE PARKING LOT
B816SS30
B816AC14
WEST ASPHALTIC CONCRETE WALKWAY AREA
STAIRS TO ROOF
B816SS29
B816AC13
B816SS28
WEST UTILITY VAULT
816
EAST 12' WIDE ROLL-UP DOOR
EAST ASPHALTIC CONCRETE AREA
ASPHALTIC CONCRETE WALKWAY
B816SS26
B816CS05
B816SS20
B816AC06
B816SS06
B816AC04
B816SS07
B816SS08
B816AC05
B816SS09
B816SS10
B816SS11
B816SS13
B816SS12
B816AC07
B816SS14
B816CS01
B816CS04
B816SS24
B816SS23
RECESSED DOORWAY
EAST UTILITY VAULT
B816SS21
B816SS17
EAST EXIT
B816SS16
B816SS18
B816CS06
B816AC12
B816CS03
B816SS27
B816AC11
B816SS25
B816CS02
B816AC10
B816SS22
SOUTH CONCRETE WALKWAY
SOUTHEAST SOIL AREA
B816AC09
B816SS19
B816AC08
B816SS15
×21.1
SOUTH ENTRANCE AREA
FENCE LINE
RAILROAD
40
30
N

LEGEND

B816SS01	SOIL SAMPLE
B816CS01	CONCRETE SAMPLE
B816AC01	ASPHALT SAMPLE
	COMPOSITING AREA BOUNDARIES
	SOIL AREAS

10' 0 10' 20'
SCALE: 1" = 20'

FIGURE 2
BUILDING 816
SOIL, ASPHALTIC CONCRETE, AND CONCRETE SAMPLE LOCATION MAP

MJU (SF) (044-0155)BLDG-816.DWG (PLOT 1"=20') - 04/14/93

TABLE 1

SAMPLES TO BE COLLECTED AT BUILDING 816

Area	Sample Matrices to be Collected		
	Soil	Concrete	Asphaltic Concrete
	Number of Samples Collected[b]	Number of Samples Collected[b]	Number of Samples Collected[b]
North Walkway Area	5	0	3
East A/C Area	9	0	4
Southeast Soil Area	7	1	2
South Entrance Area	7	5	3
West A/C Walkway Area	3	0	3
Total Number of Samples Collected	31	6	15
Total Number of Replicate Analyses[a]	2	1	1

[a] The number of replicate analyses are 5 percent of the total number of samples.
[b] One equipment blank will be collected per day.

TABLE 2

LABORATORY ANALYSIS TO BE PERFORMED ON SOIL, ASPHALTIC CONCRETE, AND CONCRETE SAMPLES

Sample Matrix	Soil	Concrete	Asphaltic Concrete
Analysis	Beta Liquid Scintillation	Beta Liquid Scintillation	Beta Liquid Scintillation
Number of Samples	31	6	15
Number of Containers and Sample Amount	31 - 200 ml plastic, screw top, gasketed jars; collect approximately 100 grams.	6 - 200 ml plastic, screw top, gasketed jars; collect approximately 100 grams.	15 - 200 ml plastic, screw top, gasketed jars; collect approximately 100 grams.
Preservation	Cool to 4°C	Cool to 4°C	Cool to 4°C
Maximum Holding Time	6 Months	6 Months	6 Months

2.1.3 Concrete Surface Sampling

Concrete will be sampled by chipping the surface with a rotohammer and scarifying tool to a depth of approximately one-half inch over a 3.5-inch diameter area. This will provide approximately 100 grams of concrete for laboratory analysis. The samples will be placed in 200-ml screw top plastic jars and stored at 4°C prior to shipment to the laboratory.

2.1.4 Asphaltic Concrete Surface Sampling

Asphaltic concrete will be sampled by chipping the surface with a rotohammer to a depth of approximately one-half inch over a 4-inch diameter area. This will provide approximately 100 grams of A/C for laboratory analysis. The samples will be placed in 200-ml screw top plastic jars and stored at 4°C prior to shipment to the laboratory. Table 3 shows the sample ID numbers of the samples to be collected at each location for each matrix.

All attachments that are referenced in Appendix A are provided in the PRC's CLEAN Draft Ionizing Radiation Protection Program dated April 18, 1993.

2.2 ANALYTICAL RESULTS

If tritium test results indicate that the MDA of 0.5 pCi/g was exceeded for any sample, the area that the sample was collected from may require further investigation.

3.0 HEALTH AND SAFETY

Work on this project will be performed in accordance with the PRC's CLEAN Health and Safety Program, Revision 1, dated April 5, 1991 and will include radiation specific health and safety protocols in accordance with PRC's CLEAN Draft Ionizing Radiation Protection Program,

TABLE 3

SAMPLES TO BE COLLECTED FROM EACH AREA

Area	ID Numbers of Samples to be Collected from each Area		
	Soil	Concrete	Asphaltic Concrete
North Walkway	B816SS01 B816SS02 B816SS03 B816SS04 B816SS05		B816AC01 B816AC02 B816AC03
East Asphaltic Concrete	B816SS06 B816SS07 B816SS08 B816SS09 B816SS10 B816SS11 B816SS12 B816SS13 B816SS14		B816AC04 B816AC05 B816AC06 B816AC07
Southeast Soil	B816SS15 B816SS16 B816SS17 B816SS18 B816SS19 B816SS20 B816SS21	B816CS01	B816AC08 B816AC09
South Entrance	B816SS22 B816SS23 B816SS24 B816SS25 B816SS26 B816SS27 B816SS28	B816CS02 B816CS03 B816CS04 B816CS05 B816CS06	B816AC10 B816AC11 B816AC12
West Asphaltic Concrete Walkway	B816SS29 B816SS30 B816SS31		B816AC13 B816AC14 B816AC15

dated April 18, 1993. An activity-specific health and safety plan (HSP) has been prepared and will be provided under separate cover.

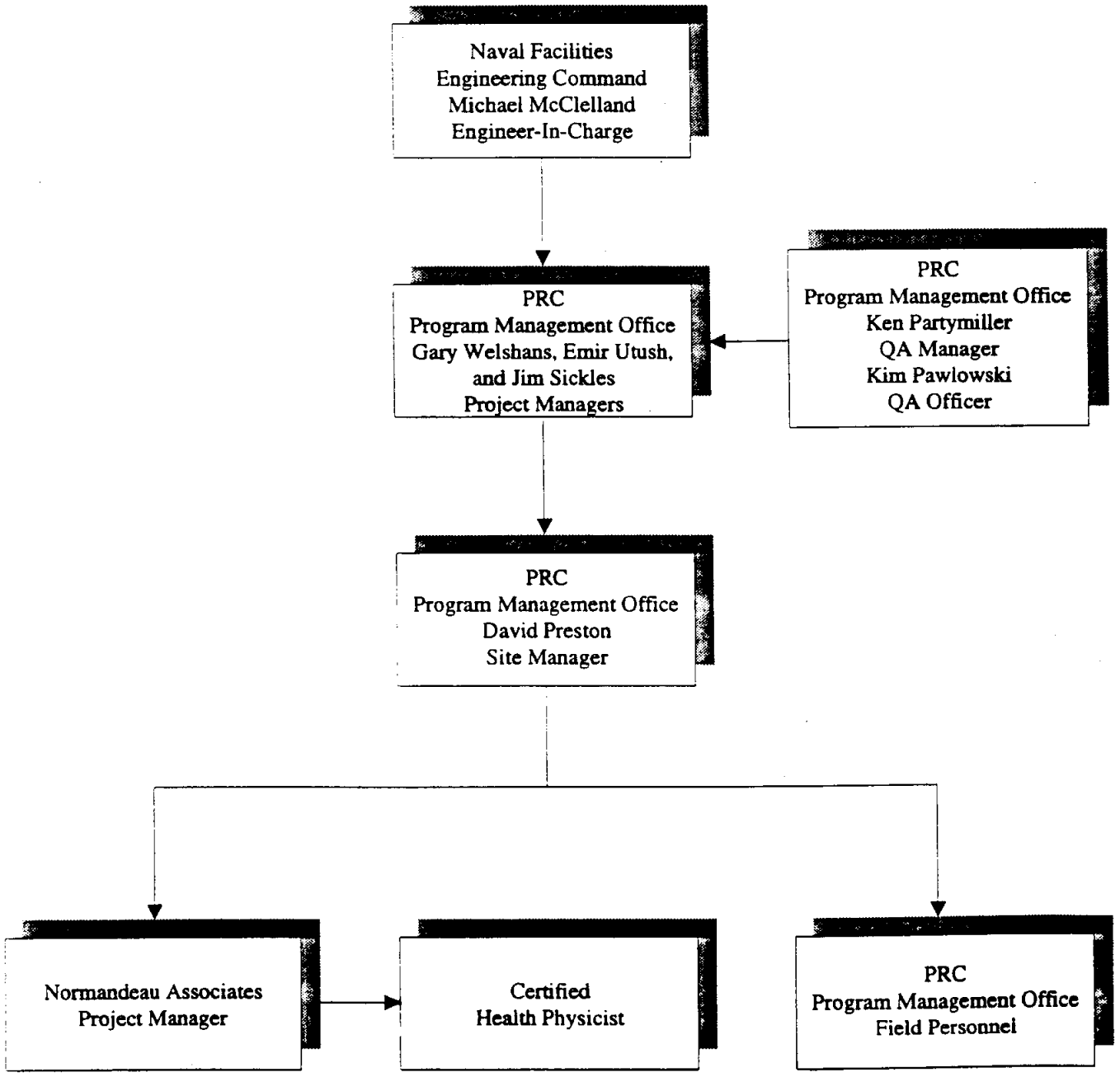
4.0 QUALITY ASSURANCE PROJECT PLAN

Work on this contract will be conducted in accordance with PRC's CLEAN Quality Assurance Management Plan dated January 17, 1990. This quality assurance project plan (QAPjP) describes the policy, organization, functional activities, and quality assurance/quality control (QA/QC) procedures to be implemented during the radiation survey. Activities defined in this work plan may be subject to a system audit to check for compliance to the QA Management Plan.

4.1 PROJECT ORGANIZATION AND RESPONSIBILITIES

Technical work proposed herein will be performed by Navy's contractor PRC and its subcontractors. The PRC project managers will ensure that the team members complete the QC requirements specified in the work plan. They will also monitor the quality of the work. The PRC project QA officer and analytical coordinator will coordinate sampling and analytical activities who will also be responsible for audits and review of analytical data. The PRC site manager will be responsible for the quality of the field investigation at HPA. The on-site safety officer (SO) will oversee all site activities, including those of subcontractors, and will ensure that all procedures described in the QAPjP and health and safety plan are adhered to in the field. The SO will ensure that field equipment is properly calibrated and maintained, and that individual samples are properly handled and documented to allow tracing the possession and handling of samples from collection to laboratory receipt. The SO has the authority to correct and change site control measures and the required health and safety protection procedures. Technical control and review will be provided by a Certified Health Physicist. Direct communication between the site manager and the project managers will enable the PRC team to produce high quality work that achieves the environmental investigation objectives, and addresses the Navy's needs. Figure 3 presents a project and QA organization chart for this project.

FIGURE 3
PROJECT AND QA ORGANIZATION CHART



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4.2 DATA ASSESSMENT PROCEDURES

Critical indicators of project data quality are precision, accuracy, representativeness, completeness, and comparability (PARCC). Objectives for these indicator parameters were developed based on past experience and on the objectives of the site investigation.

4.2.1 Precision

Precision is the degree of mutual agreement between individual measurements of the same property under prescribed similar conditions. Precision will be assessed by calculating the RPD, and by calculating the SD of the activity levels of the replicate analyses, as follows:

$$RPD = \frac{R_1 - R_2}{(R_1 + R_2)/2} \times 100\%$$

Where R_1 = Original Sample

R_2 = Duplicate Sample

$$SD = \left[\frac{\Sigma(X - \overline{X})^2}{n-1}\right]^{1/2}$$

Where X = observed value

$\overline{X}$ = mean value

n = number of observations

The precision of chemical analyses will be assessed through the analysis of field duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, and matrix duplicates. Sample duplicates and MS/MSD samples will be analyzed at a frequency of 1 every 20 samples. General precision acceptance criteria are presented in Table 4. When analytes are present in samples near the MDA, the objectives may not be met, and other QC data will be evaluated to determine the validity of the data.

TABLE 4

SUMMARY OF ANALYTICAL METHODS AND QA OBJECTIVES

Analytical Parameter	Sample Matrix	Minimum Detectable Activity (pCi/g)	Precision Objective %	Accuracy Objective %	Reference Method
Tritium	Soil	0.5	50	40 - 140	EP-211[1]
	Concrete	0.5	50	40 - 140	EP-211[2]
	Asphaltic Concrete	0.5	50	40 - 140	EP-211[3]

Notes:

[1] TMA/Norcal laboratory environmental analytical procedures for soil.
[2] TMA/Norcal laboratory environmental analytical procedures for concrete.
[3] TMA/Norcal laboratory environmental analytical procedures for asphaltic concrete.

4.2.2 Accuracy

Accuracy refers to the degree of agreement of a measurement to the true value. The accuracy of a measurement system is affected by errors introduced through the sampling process, field contamination, preservation, handling, sample matrix, and analytical preparations and techniques.

To evaluate laboratory accuracy, a program of sample spiking will be conducted by the analytical laboratory. This program includes the analysis of MS/MSD samples, laboratory control samples (LCS) or blank spikes, and method blanks. Accuracy will be assessed by calculating the percent recovery (%R) of laboratory matrix spikes as follows:

$$\%R = \frac{S_1 - S_2}{S_t} \times 100\%$$

Where S_1 = measured concentration in spiked sample aliquot

S_2 = measured concentration in unspiked sample aliquot

S_t = actual concentration of spike compound added

If the tritium spiking level is not specified in the TMA/Norcal method, spiking will be done at 10 to 20 times the MDA or at a mid-level calibration level, as appropriate. General accuracy objectives are listed in Table 4.

4.2.3 Representativeness

Representativeness expresses the degree to which sample data accurately represent the characteristics of a population, or the environmental condition they are intended to represent. Representativeness will be obtained through the careful selection of sampling sites, through proper collection and handling of samples, and through the use of established field and analytical procedures and their consistent application. Data determined to be non-representative will be used only if appropriate qualifiers and limits of uncertainty accompany the data.

4.2.4 Completeness

Completeness is defined as percentage of measurements that are judged valid. The project completeness will be calculated by dividing the number of usable data results (data points) by the total number of data points in the data set. The completeness objective for this project is 90 percent.

4.2.5 Comparability

Comparability is a qualitative parameter that expresses the confidence that one data set may be compared to another. This goal is achieved through the use of standardized techniques to collect and analyze samples and appropriate units to report analytical results.

4.3 SAMPLING PROCEDURES

Soil, concrete, and AC sampling and analysis will be conducted to assess the presence of tritium outside Building 816. Samples will be recovered using a variety of sampling techniques, described in Section 2.0 of this document. All analyses will be performed at the contract laboratory. A summary of the analytical technique, sample containers, holding times, and preservation requirements are presented in Table 2.

4.3.1 Sample Custody Procedures

Documentation during sampling activities is essential to ensure proper sample identification. Standard sample custody procedures will be used to maintain and document sample integrity during collection, transportation, storage, and analysis. The site manager is responsible for proper sample handling and documentation that will allow PRC to trace the samples from the time of collection to laboratory receipt. The QA officer is responsible for establishing a sample control system that will allow tracing sample possession from laboratory receipt to final sample disposition.

Appendix A provides a complete description of sampling techniques, sample custody procedures, and sample and materials shipment requirements for radiological investigations. Internal laboratory chain-

of-custody procedures will be followed by the analytical laboratory, outlined in the TMA/Norcal Quality Assurance Manual contained in Appendix B.

4.4 CALIBRATION PROCEDURES AND FREQUENCY

Laboratory and field measuring and testing equipment will be identified, and calibrated in accordance with EPA guidelines, the laboratory QA plan, or the manufacturer's recommendations. Measuring equipment, test equipment, and reference standards will be calibrated at prescribed intervals before use. The site manager will be responsible for ensuring that the field equipment is properly calibrated.

In some cases, particularly for field equipment, the frequency of calibration is dependent on the type and stability of the equipment, the analytical method used, and the intended use of the equipment. Equipment that can no longer be calibrated or becomes inoperable during field activities will be removed from service, tagged, and segregated to prevent inadvertent use. Backup systems will be available for each type of measurement system in use and will be calibrated prior to use in the field.

Records will be prepared and maintained for each piece of measuring and test equipment and reference equipment to indicate that established procedures have been followed. Records for equipment used will be kept in the project files.

4.5 PREVENTIVE MAINTENANCE

All equipment will receive routine maintenance checks in order to minimize equipment breakdowns in the field. Maintenance checks will generally coincide with calibration checks. Any equipment found to be operating improperly will be tagged, taken out of use, and a note stating the time and date of this action will be made in a field log book. The equipment will be repaired, replaced or recalibrated, as necessary, and the time and date of its return to service will also be recorded. Table 5 provides a summary of preventive maintenance requirements of project field equipment.

TABLE 5

FIELD EQUIPMENT MAINTENANCE CHECKS SCHEDULE

Instrument to be field checked	Standard Reference	Acceptance Specifications	Response Check Schedule
Gamma Detector:			
Sodium iodide scintillation detector	Americium-241 calibrated source or Cesium-137 check source	Meter deflection	Daily or before use
Alpha Detector:			
Zinc sulfide alpha scintillation detector	Thorium-230	Meter deflection	Daily or before use
Beta/ Gamma Detector:			
Geiger Mueller	Cesium -137 check source	Meter deflection	Daily or before use

4.6 ANALYTICAL PROCEDURES AND MINIMUM DETECTABLE ACTIVITY

Sample analysis will be subcontracted to the TMA/Norcal laboratory in Richmond, California. Analytical procedures for this project will follow TMA/Norcal in-house method EP-211, as stated in Table 4. The MDA is 0.5 pCi/g.

The matrix will be finely crushed followed by a water extraction step. Tritium will be analyzed using a beta liquid scintillator. Appendix C provides the TMA/Norcal method of tritium analysis.

4.7 INTERNAL QUALITY CONTROL CHECKS

The principal functions of any sampling and analysis program are to collect representative environmental samples and to provide accurate analytical data using approved methods. To achieve these goals, a program has been developed through which field and laboratory data are assessed. The quality of field data will be determined through the use of field QC samples. Laboratory QC samples will be analyzed to ensure that laboratory analytical processes are functioning properly. PRC's internal QA program includes:

- Documentation of sampling procedures;
- Chain-of-custody record forms;
- Documentation of field work;
- Identification and correction of non-conformance situations through audit systems; and
- Interaction with Navy personnel concerning work schedules, field procedures, subcontractors, and laboratory performance.

4.7.1 Field Quality Control Samples

Equipment blanks will be collected at a rate of one per day per type of sampling equipment used. Field duplicates will be collected at a frequency of 1 every 20 samples, or one per week, whichever is greater.

4.7.2 Laboratory Quality Control Samples

In addition to the QC samples collected in the field, the laboratory will analyze method blanks, matrix spike and matrix spike duplicate (MS/MSD), and laboratory control spikes (LCS) at a frequency of one for every sample delivery group (SDG), or type of matrix, or twenty samples, whichever is more frequent.

4.8 DATA REDUCTION, VALIDATION, AND REPORTING

To ensure that data management activities provide an accurate and controlled flow of data, it is important that data handling and reporting steps be defined and implemented. Data management procedures are applicable to field- and laboratory-generated data.

4.8.1 Field Data Reduction and Reporting

Data generated in the field will be recorded in project-specific field notebooks or on customized data sheets. All calculations will be clearly defined and recorded. The field team leader will review all field documentation to ensure completeness and legibility. Field data requirements include documentation of field activities and measurements in log books and field sheets, and transfer to the radiation survey report.

4.8.2 Laboratory Data Reduction and Reporting

Data reports generated from laboratory analysis will include sample control, analytical, and statistical parameters. The parameters include the measured analytical results, the analytical results expressed with the calculated two standard deviations above and below the result, and the critical count level. The data report will also include copies of the chains-of-custody forms, analytical methods used, aliquot information, preparation information, continuing calibration data for liquid scintillation counters, and copies of raw data sheets.

The laboratory data package will include internal QC data, analysis data results, audit reports, and corrective actions, if available. Laboratory data format and reporting methods are dependent on

specific needs of the project, such as (1) whether an explanatory text is required, (2) specific client or contract requirements, and (3) government agency reporting formats. The following items are applicable in the presentation of data:

- The final data package will be checked in accordance with data verification requirements and approved by the laboratory manager or designated representative.
- Data is presented in a tabular format whenever possible.
- Data for field QC samples will be reported in the same format as real samples. A modified Contract Laboratory Program (CLP) data package consisting of QC summary data sheets will be provided for all internal laboratory QC samples.
- Laboratory data will be stored so that a complete, modified CLP data package can be subsequently assembled for designated review by independent validation.

4.9 PERFORMANCE, SYSTEM, AND FIELD AUDITS

Audit procedures will be used in the QA program to assess and document performance on the radiation survey activities. Audits are performed by the program QA manager, and/or senior technical staff. A copy of the audit report will be submitted to the Navy Engineer-in-Charge (EIC).

Audits may include: evaluating project plan adherence; personnel training status; health and safety reviews; activity performance and records; budget status; QC data; calibrations; conformance to SOPs; and compliance with laws, regulations, policies, and procedures. An individual audit plan is developed to provide a basis for each audit.

All auditors will be independent of the activities audited. When an independent auditor or audit team is required, the auditor is selected based on the activities to be audited. The selection process considers technical expertise and experience in auditing.

Following completion of an audit, an audit report will be prepared and submitted to PRC and the Navy EIC. The PRC QA manager coordinates a management review of any deficiencies that are noted during the audit process. The auditor can issue a corrective action request to identify and

schedule specific corrective actions to be undertaken and completed by the project manager. Completion of corrective actions is verified by the auditor or audit team. After acceptance and verification of all corrective actions, the corrective action request form will be used to close out the audit. The two principal types of audits are system, performance and field audits. They are explained below.

4.9.1 System Audits

A systems audit consists of a qualitative review and coordination of the components of a total (quality assurance) system to arrive at a measure of the capability and ability of the system. A system audit includes a careful evaluation of field and laboratory QC procedures.

4.9.2 Performance Audits

A performance audit consists of an evaluation of the procedures or processes used to generate data by the field sampling and analysis system.

4.9.3 Field Audit

A field audit will involve an on-site assessment by the auditor. Items to be examined may, as appropriate, include: the availability and implementation of approved work procedures; calibration and operation of equipment; packaging, storage, and shipping of samples; preventive maintenance; documentation of procedures and instructions; and non-conformance documentation.

4.10 NON-CONFORMANCE AND CORRECTIVE ACTIONS

A non-conformance situation is defined as a malfunction, failure, deficiency, or deviation that renders the quality of data unacceptable or indeterminate. The QAPjP requires the rapid identification of situations that jeopardize the integrity of data collection systems.

Upon identification of non-conformance situations, corrective actions are initiated to return the system to within prescribed acceptable limits. A corrective action request form is used to initiate and

document all corrective actions. This form may be initiated by the project manager, QA officer, or any individual who observes a major problem.

Copies of the corrective action request form are given to the project manager and QA manager who will discuss each problem jointly to:

- Determine when the problem arose;
- Assign responsibility for investigating and documenting the problem;
- Determine the impact of the problem on the data quality;
- Determine what specific corrective action is needed to eliminate the problem;
- Set a time schedule and assign responsibility for implementing the required corrective action;
- Verify and document that the corrective action has eliminated the problem; and
- Determine whether notification to Navy is necessary. Corrective action is not complete until the problem has been solved effectively and permanently. Follow-up action to ensure that the problem remains corrected is an important step in the corrective action procedure.

The program QA officer has the authority to require environmental measurements that are compromised to be discontinued or limited until corrective action is complete and data quality is no longer questionable. The program QA officer also may order the reanalysis of samples or measurements occurring since the last documented evidence that the system was in control.

The laboratory QA coordinator is responsible for assessment of QC sample information. If QC data fall outside accepted limits, the QA coordinator will immediately notify the laboratory operations manager and the responsible group leader. The operations manager and group leader will identify the source of non-conformance and initiate corrective action. If the situation is not corrected and an out of control condition occurs or is expected to occur, the QA/QC coordinator will notify the laboratory technical director and the laboratory manager. Completion of corrective action should be evidenced by data returning to prescribed acceptable limits.

4.11 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The final report will be prepared by the project manager or his representative and will include a QC section presenting the results of QA procedures undertaken during this project. Analytical results of quality control samples will be summarized to demonstrate that DQO (Table 4) for this project have been achieved. This section may include the results of performance and system audits, recommended corrective actions, results of corrective actions, and deviations from the approved work plan.

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APPENDIX A
RADIOLOGICAL SOIL SAMPLING AND SAMPLE SHIPMENT PROTOCOLS (SECTIONS 17.0 AND 22.0 FROM PRC'S CLEAN DRAFT IONIZING RADIATION PROTECTION PROGRAM, APRIL 18, 1993)

17.0 AIR, SOIL, AND WATER RADIOLOGICAL SAMPLING

17.1 SOIL AND WATER SAMPLING TECHNIQUES

17.1.1 Systematic and Biased Surface Soil Radiological Sampling

The purpose of these procedures for systematic and biased surface soil radiological sampling is to establish radiological systematic and bias surface soil sampling techniques for collecting surface soil during remedial action, characterization or other activities at CLEAN project work sites. These procedures supplement the FSP or SAP for a specific CLEAN project work site.

This procedure describes the systematic and bias surface soil radiological sampling techniques, applicable forms, sample labels, decontamination of sampling equipment and identification of sampling locations. Additional guidance is provided for requirements as specified within EPA documents.

The applicable references are:

- "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods" SW-846, Third Edition, Proposed Update Package, 1989.
- "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods" SW-846, Third Edition Revised, November, 1990 (updates).
- "A Compendium Of Superfund Field Operations Methods" EPA 540 P-87 001, December 1987, Section 4.
- Section 16.3.3, "Gamma Ray Exposure Rate Surveys at One Meter in Open and Enclosed Areas."
- Section 16.3.4, "Walkover Gamma Ray Scan."

17.1.1.1 Necessary Supplies

- Sample containers (500 ml Nalgene® jars, etc)
- Sampling equipment as required
- Labels
- "Field Sample Collection Form," shown as Attachment 29
- Measuring tape
- "Custody Seal," shown as Attachment 30

- Alconox® or Liquinox® (or standard brand of phosphate-free detergent), deionized water (DI), spray bottles, 5-gallon plastic buckets (3), and soft bristle brushes (3)
- Radiological field sample collection logbook(s)

17.1.1.2 Specific Instructions

Sample collection for radiological analysis parameters on CLEAN project work sites requires that samples be collected consistent with the guidance specified in EPA documents. This includes sampling technique, sampling equipment decontamination, and documentation.

The frequency and number of systematic surface soil samples usually will be specified in the FSP or SAP. The number of samples collected will depend on site-specific information such as elevated gamma ray readings as detected from gamma ray scans conducted in accordance with Section 16.3.3, "Gamma Ray Exposure Rate Surveys at One Meter in Open and Enclosed Areas," and Section 16.3.4, "Walkover Gamma Ray Scan." Direction from instruction guides, FSPs, SAPs, or other written instruction are required for all sampling events.

Prior to start of sampling, tools and equipment must be cleaned as specified below:

- Sampling tools for radioactive materials must be washed using a solution of Alconox® or Liquinox® and water. A soft bristle brush should be used to remove any visible material from sampling tools and equipment. Sampling tools will be rinsed with DI water and allowed to air dry. After drying, tools should be covered with aluminum foil or wrapped in plastic to preclude their contamination until used.
- Prior to sampling, a bound, page-numbered sample logbook will be established, and during sampling the information below will be entered:

  - Purpose of sampling (e.g., characterization, remedial action, and so forth)
  - Coordinates of sampling point, and depth of sampling
  - Name of PRC's field technical staff doing the sampling
  - Type of sample (e.g., soil, water, and so forth)
  - Number of samples and volume taken

- Description of sampling point and sampling methodology.
- Date and time of collection.

- Sample identification number(s).
- Sample distribution and method of transportation (e.g., cooler, United Parcel Service or Federal Express).
- Name of analytical laboratory
- References such as maps or photographs of the sampling site.
- Field observations such as weather conditions, wind direction, wind speed, and relative humidity must be entered into the sample logbook.
- Any measurements taken (e.g., pH, soil density, flammability, explosivity).
- Signatures of PRC's field technical staff who sample or make any observations.
- Method used for decontamination of sampling equipment.
- For composite samples, method of compositing.

Note: All entries into the sample logbook must be made in black ink.

All information must be included in the field sampling logbook to adequately reconstruct the sampling event. A custody seal, shown as Attachment 30, will be placed on sample containers by PRC's field technical staff taking samples prior to turning these samples over to other field technicians for shipment. Custody seals must be dated and signed by PRC's field technical staff collecting the sample.

A sample is considered to be under a person's custody if (1) it is in a person's physical possession, (2) in view of the person after he has taken possession, (3) secured by that person so that no one can tamper with the sample, or (4) secured by that person in an area that is restricted to authorized personnel.

17.1.1.4 Documentation

- Using the Field Sample Collection Form

Each soil sample collected will be assigned a sequential number and recorded in the field sample collection logbook. Sample information should then be documented on the form shown as "Field Sample Collection Form," Attachment 29. Documentation on the Field Sample Collection Form should contain the following information:

- Site number

- Site name
- Activity support (job) number
- Name of PRC's field technical staff doing the sampling
- Sample identification number
- Sample grid points
- Sample type
- Time sample was collected
- Date sample was collected
- Sample preservative used
- Purpose
- Depth (in centimeters or feet)
- Analysis required
- Remarks
- Chain-of-custody information
- Recorded by
- Date and time form was completed
- Number of samples in each shipping container
- Total number of samples in shipment
- Total number of boxes in shipment

The names of PRC's field technical staff who collected the samples should be recorded in the field sample collection logbook . Document all facts about the sample on the Field Sample Collection Form and enclose the original Field Sample Collection Form with the samples to be shipped to the analytical laboratory.

To help ensure that each sample has been properly handled, a chain-of-custody procedure must be followed. For chain-of-custody reporting, enter the following information in the appropriate box of the Field Sample Collection Form:

- Reason the sample is being released from the site (i.e., shipment, archival, analysis, and so forth).
- Person physically relinquishing the sample to the carrier (consignee).
- Person or consignor (e.g., United Parcel Service or Federal Express).
- Date and approximate time the sample was released to the consignor (time the sample leaves

the site or is delivered to the consignor).

- Personnel at the analytical laboratory (or location that receives the sample) will acknowledge receipt of the sample on the next line of the chain-of-custody box by their signature in the "received by" column, and by entering the date and time the sample was received.

A copy of the Field Sample Collection Form should be provided to PRC's PM and PRC's HSC by PRC's site-specific ORPO. A copy should be retained for the onsite records.

Upon receipt of samples in the analytical laboratory, receiving personnel should acknowledge the shipment by completion of appropriate information in the chain-of-custody section of the Field Sample Collection Form. The laboratory must also note within the remarks section of this form if custody seals have been violated.

17.1.2.2 Specific Instructions

Sample collection for radiological analysis parameters on CLEAN project work sites requires that samples be collected as specified within EPA documents. This includes sampling technique, sampling equipment decontamination, and documentation.

- The frequency and number of subsurface soil samples will be determined by the site characterization plan, or by written guidance provided by PRC's PM. If PRC's PM makes decisions about the number or frequency of samples, he or she must advise the team leader for that site. The number of samples collected will depend on site-specific information such as elevated gamma ray readings and direction from project management personnel to assure the property is adequately covered.
- Instruction guides, FSPs, SAPs, or other written instruction are required for all sampling events. PRC's PM will provide necessary guidance documents.
- Prior to starting of sampling, tools and equipment must be thoroughly cleaned. Sampling tools will be washed using a solution of Alconox® or Liquinox® and water. A soft bristle brush will be used to remove any visible material from sampling tools and equipment. Sampling tools will be rinsed with DI water and allowed to air dry. After drying, tools will be covered with aluminum foil or wrapped in plastic to prevent their contamination until used.
- Prior to sampling, a bound, page-numbered sample logbook will be used. During sampling the following information should be recorded in the logbook:

  - Purpose of sampling (e.g., characterization, remedial action, and so forth)
  - Coordinates of sampling point, and depth of sampling
  - Names of PRC's field technical staff doing the sampling

- Sample matrix (e.g., soil, water, and so forth)
- Number of samples and volume taken
- Description of sampling point and sampling methodology
- Date and time of collection
- Sample identification number(s)
- Sample distribution and method of transportation (e.g., cooler, United Parcel Service or Federal Express)
- Name of analytical laboratory
- References such as maps or photographs of the sampling site.
- Field observations such as weather conditions, wind direction, wind speed, and relative humidity must be entered into the sample logbook even when work is conducted inside a building or structure.
- Any measurements made (e.g., pH, soil density, flammability, explosivity, and so forth).
- Signatures of personnel who sample or make any observations.
- Method used for decontamination of sampling equipment.
- For composite samples, method of compositing.

Note: All entries into the sample logbook must be done in black ink.

All information must be included in the field sampling logbook to adequately reconstruct the sampling event. Custody seals, shown as Attachment 30, will be placed on sample containers by PRC's field technical staff taking samples prior to turning these samples over to other field technicians for shipment. Custody seals must be dated and signed by PRC's field technical staff collecting the sample.

A sample is considered to be under a person's custody if (1) it is in a person's physical possession, (2) in view of the person after he has taken possession, (3) secured by that person so that no one can tamper with the sample, or (4) secured by that person in an area that is restricted to authorized personnel.

17.1.2.9 Documentation Using the Field Sample Collection Form

Each subsurface soil sample collected should be assigned a sequential number and recorded in the field sample collection logbook. Sample information should then be documented on the form, shown as "Field Sample Collection Form," Attachment 29. Documentation on the form should contain the

following information:

- Site number
- Site name
- Activity support (job) number
- Name of PRC's field technical staff doing the sampling
- Sample identification number
- Sample grid points
- Sample type
- Time sample was collected
- Date sample was collected
- Sample preservative used
- Purpose
- Depth (in centimeters or feet)
- Analyses required
- Remarks
- Chain-of-custody information
- Recorded by
- Date and time form was completed
- Number of samples in each shipping container
- Total number of samples in shipment
- Total number of boxes in shipment

Record in the field sample collection logbook the names of PRC's field technical staff who collected the samples. Document all facts about the sample on the Field Sample Collection Form and enclose the original Field Sample Collection Form with samples to be shipped to the laboratory.

To help ensure that each sample has been properly handled, a chain-of-custody procedure must be followed. For chain-of-custody reporting, enter the following information in the appropriate box of the Field Sample Collection Form:

- Reason the sample is being released from the site (i.e., shipment, archival, analysis, and so forth)
- Person physically relinquishing the sample to the carrier (consignee)
- Person or consignor (e.g., United Parcel Service or Federal Express)

- Date and approximate time the sample was released to the consignor (time the sample leaves the site or is delivered to the consignor)
- Personnel at the laboratory (or location that receives the sample) will acknowledge receipt of the sample on the next line of the chain-of-custody box by their signature in the "received by" column, and entering the date and time the sample was received

A copy of the Field Sample Collection Form should be provided to PRC's PM and PRC's HSC by PRC's site-specific ORPO. A copy should be retained for the onsite records.

Upon receipt of the samples in the analytical laboratory, receiving personnel should acknowledge the shipment by completing appropriate information in the chain-of-custody section of the Field Sample Collection Form. The laboratory should also note within the remarks section of the form if custody seals have been violated.

22.0 RADIOACTIVE MATERIALS SHIPMENTS

Radioactive material shipments could include soils, radioactive sources, contaminated tools or equipment, samples, etc. PRC and each subcontractor on a CLEAN project work site is responsible for shipping their own radioactive material in accordance U.S. Department of Transportation (DOT) regulations. DOT regulations apply only to radioactive materials having a specific activity of at least 2,000 pCi per gram (pCi/gm). Samples with a specific activity less that 2,000 pCI/gm are designated as "Excepted Package, Limited Quantity" by DOT, and shall be shipped in accordance with the instructions presented in Section 22.2

PRC and each contractor onsite that ships radioactive materials (including contaminated soil) is responsible for verifying that the radioactive material they ship can legally be received by the intended recipient.

22.1 REFERENCES AND REGULATIONS

Anyone that ships radioactive material should review the following references:

- "A Review of the Department of Transportation Regulations for the Transportation of Radioactive Materials," DOT, September 1983.
- 49 CFR 1-179, Hazardous Material Regulations, DOT, 1992.

22.2 SHIPPING RADIOACTIVE CHECK SOURCES

The following procedure will be used to transport "limited quantity" radioactive check sources.

- Place the radioactive check source in an envelope or container. Use appropriate fasteners or tape to seal the inside package.
- Affix a label to the inner package bearing the term "Radioactive."
- Place the inner package into a padded envelope or sturdy box before shipping. Insert a packing list into the outer container or attach it to the outside of the outer container. Seal the outer container using fasteners or tape.
- The packing list must contain the following information:

- Name of consignor or consignee
- Address of consignor or consignee
- Statement: "This package conforms to the conditions and limitations specified in 49 173.421 for excepted radioactive material, limited quantity, not otherwise specified, UN2910."

- Survey the package to ensure that it meets the following limitations:

  - The radiation level at the surface of the package must be less than 0.5 mrem/hr.
  - There must be no significant removable contamination on the surface of the package.

    - For alpha emitting radionuclides the removable contamination limit is 2.22 dpm per square centimeter (dpm/cm^2).
    - For beta emitting radionuclides the removalbe contamination limit is 22.0 dpm/cm^2.

- The quantity limitations specified for a single container are as follows:

Radionuclide	Package Limit (millicurie) Normal form
Americium-241	0.008
Plutonium-239	0.002
Radium-226	0.050
Strontium-90	0.400
Cesium-137	10.000
Technetium-99	25.000
Thorium-230	0.003

- Sources packaged under "limited quantity" provisions of 49 CFR 173 may be shipped via commercial carriers or by personal vehicle. They may also be placed in packages containing other field materials, such as ionizing radiation survey instruments, sampling tools, etc. Labeling of the outer containers is not required. There is no limitation on the number of "limited quantity" packages per vehicle.

PRC

ATTACHMENT 29

FIELD SAMPLE COLLECTION FORM

Page of

SITE ACTIVITY SAMPLES

Site No. _____ Site Name _____ Activity Support (Job) No. _____ Sampler(s) _____

Sample I.D. No. _____ Sample Grid Point	Sample Type (1)	Sample Time	Date of Sample	Preservative	Purpose (2)	Depth cm [ ] ft [ ]	Analysis Required	Remarks

SAMPLE TYPE (1)
SS Surface Soil
BS Bias Soil
PS Profile Soil
SD Sediment Silt
OR Other
VE Vegetation
GW Ground Water
SW Surface Water

PURPOSE (2)
RC Rad Character
VR Verification
QC Quality Control
HS Hot Spot
RS Resample
BG Background
RT Routine
SP Special

*This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive material, limited quantity, not otherwise specficied UN 2910

CHAIN OF CUSTODY

REASON	RELNQ BY	REC'D BY	DATE	TIME

Recorded By _____

Date/Time _____

No. of Samples in the box

Total No. of Samples in this shipment

Total No. of Boxes in this

SHIPPER:

SHIP TO:

APPENDIX B

TMA/NORCAL QUALITY ASSURANCE MANUAL

TMA

Thermo Analytical Inc.

TMA/NORCAL
QUALITY ASSURANCE MANUAL

"quality environmental analyses"

UNCONTROLLED

☐ Controlled ☐ Uncontrolled

Copy No. _____ Issue Date _____

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AUTHORIZATION AND APPROVAL STATEMENT

THIS QUALITY ASSURANCE MANUAL, WITH ALL REVISIONS, IS AUTHORIZEDAND APPROVED IN ITS ENTIRETY BY:

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STATEMENT OF COMPLIANCE

This Quality Assurance Manual includes instructions outlined in ASME NQA-1-1989 "Quality Assurance Program Requirements for Nuclear Facilities," NRC 10 CFR Part 50, Appendix B "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," and QAMS 005/80 "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" as elements that must be considered for inclusion in all Quality Assurance Project Plans. As illustrated below, the required element item numbers are listed on the right, appropriate coverage of that element is by the numbered section with title listed on the left. Item 3 (Design Control) from NQA-1 does not apply. Item III (Design Control) from 10 CFR 50 does not apply. Item 6 (Sampling Procedures) from QAMS 005/80 does not apply.

SECTION	TITLE	NQA-1	10 CFR 50	QAMS 005/80
	TITLE PAGE	N/A	N/A	1
	TABLE OF CONTENTS	N/A	N/A	2
1	INTRODUCTION AND DESCRIPTION	N/A	N/A	3
2	ORGANIZATION AND RESPONSIBILITY	1	I	4
3	QUALITY ASSURANCE OBJECTIVES	2	II	5
4	PERSONNEL INDOCTRINATION, TRAINING, AND JOB EVALUATION	2	II	N/A
5	INSTRUCTIONS AND PROCEDURES	5	V	14
6	PROCUREMENT DOCUMENT CONTROL	4	IV	N/A
7	MATERIAL RECEIPT AND CONTROL	7	VII	N/A
8	MATERIAL STORAGE AND CONTROL	8,13, 15	VIII,XIII, XV	N/A
9	CONTROL OF PROCESS	9	IX	7,9
10	PREVENTIVE MAINTENANCE	N/A	N/A	13
11	CONTROL OF MEASUREMENT AND TEST EQUIPMENT	12	XII	8
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INTRODUCTION AND DESCRIPTION

1.1 PREFACE

The management of TMA/Norcal is committed to a rigorous Quality Assurance (Q.A.) Program. While this commitment is necessary for the normal conduct of business, our basic policies dictate the highest standards of ethics and integrity in the conduct of our affairs. This philosophy and the specific procedures to attain the objectives form the framework of our Q.A. Program. TMA/Norcal provides services with confidence that our Q.A. Program and all related operating procedures dictate reliable performance of those services. The requirements of this Q.A. Manual are consistent, to the extent possible, with the Quality Assurance/Quality Control (QA/QC) requirements of the other Thermo Analytical, Inc. laboratories.

1.2 PURPOSE

The purpose of this manual is to outline management Q.A. policy and to delineate the procedures to be used to accomplish each of the quality assurance elements necessary to fulfill TMA/Norcal's responsibility to meet and/or exceed client or regulatory specifications. It also provides a means for creating mutual understanding, regarding our Q.A. program and reliability techniques, with our subcontractors, vendors, and clients.

1.3 SCOPE

In addition to the documents listed in the Statement of Compliance, this Manual complies with applicable requirements of the following regulations:

1.3.1 NRC 10 CFR Part 21, "Reporting of Defects and Non-compliance"

1.3.2 NRC Regulatory Guide 4.15 Rev. 1, "Quality Assurance for Radiological Monitoring Programs - Effluent Streams and the Environment."

1.3.3 ANSI Standard N413-1974 "Guidelines for the Documentation of Digital Computer Programs."

1.4 DESCRIPTION

This document outlines the organization of the Quality Assurance function, describes and depicts the lines of authority, and lists the duties and responsibilities within the organization. It provides guidance for the preparation of Procedures Manuals which provide the detailed methods of operations and analyses that accomplish the goal of quality data in terms of precision, accuracy, and reproducibility.

1.5 CONFIDENTIAL AND PROPRIETARY INFORMATION

TMA/Norcal employees are exposed to confidential and/or proprietary information pertaining to the company and it's clients. Information concerning the report of analysis, radiation dosimetry records, audit reports, calibration reports, and other correspondence from clients is considered confidential. This information is to be released only to the client or to the client's authorized representative. Each employee shall sign an agreement with TMA/Norcal concerning the security of proprietary and confidential information. A copy of the agreement shall be retained in the employee's personnel file.

1.6 TECHNICAL COMPLAINTS

Technical complaints will be addressed by the Technical Director. If the complaint is not valid, every attempt will be made to satisfy the client. If the complaint is determined to be valid, then the cause of the complaint shall be identified and corrected as soon as feasible. Verification that the cause for a valid complaint has been corrected is the responsibility of the Technical Director. Details of all complaints shall be recorded in the customer's project file.

ORGANIZATION AND RESPONSIBILITY

2.1 ORGANIZATIONAL STRUCTURE

The organizational structure, functional responsibilities, levels of authority, and lines of communication for management's direction and execution of the Q.A. Program are documented in this section.

2.2 RESPONSIBILITY

The delineation of authority and the responsibility of persons and organizations performing activities affecting quality are established as follows:

2.2.1 The Q.A. Manager is responsible for the establishment and execution of the Q.A. Program and for defining and measuring the overall program effectiveness.

2.2.2 The Q.A. Manager reports directly to the President, TMA/Norcal, providing the required authority and organizational freedom to assure that appropriate action can be taken in implementing an effective program. The Q.A. Manager shall have sufficient independence from cost and scheduling considerations, and has authority to control processing, delivery, installation, or use until proper disposition of a nonconformance, deficiency, or unsatisfactory condition that has occured.

2.2.3 The Q.A. Manager has direct access to the Thermo Analytical (TMA) Corporate Quality Assurance Program Manager who can defer to the authority of the President of TMA on matters pertaining to quality assurance for resolving problems that cannot be resolved at company level.

2.2.4 The Q.A. Manager is responsible for reviewing the Q.A. Program on a continuing basis and revising the program as necessary to assure compliance with the latest revisions of applicable regulations. A formal review of the program shall be performed annually.

2.2.5 Quality related activities are assigned to specific qualified personnel.

2.2.6 Responsibility for specific quality control functions reside with the Q.A. Officer and the Quality Control (Q.C.) Coordinator.

2.2.7 The Q.A. Officer reports directly to the Q.A. Manager.

2.2.8 The Q.C. Coordinator reports directly to the Q.A. Manager on matters pertaining to quality assurance.

2.2.9 The Q.A. Manager and the Q.A. Officer are authorized to sign Certificates of Conformance and/or Compliance.

2.2.10 The Q.A. Officer and Q.C. Coordinator shall monitor the adequacy of the Q.A. Program portions for which they are responsible and recommend improvements, additions, or deletions to the program. Should a condition adverse to quality be observed, the Q.A. Manager and tne Laboratory Operations Manager shall be advised. The Laboratory Operations Manager, or designee, shall investigate the cause and determine the action necessary to correct the condition and to prevent recurrence.

2.2.11 The Sample Control Q.C. Coordinator is responsible for inhouse inspections of the Sample Control Department and for monthly quality control reports.

2.2.12 Duties and responsibilities of personnel with Q.A./Q.C. functions are detailed in Q.A. Procedure (QAP) -03 "Quality Assurance Responsibilities."

2.2.13 The responsibility for compliance to the general workmanship and standard practices is vested in the first line level of supervision. The Supervisors shall indoctrinate and enforce employee compliance.

2.2.14 Every employee is responsible for supporting the Q.A. Program in principle and in detail.

2.2.15 The President, TMA/Norcal, and designated managers, shall annually assess the Q.A. Program to evaluate its adequacy and assure its effective implementation.

2.3 ORGANIZATIONAL CHARTS

2.3.1 The Corporate Organization is illustrated in Figure 1.

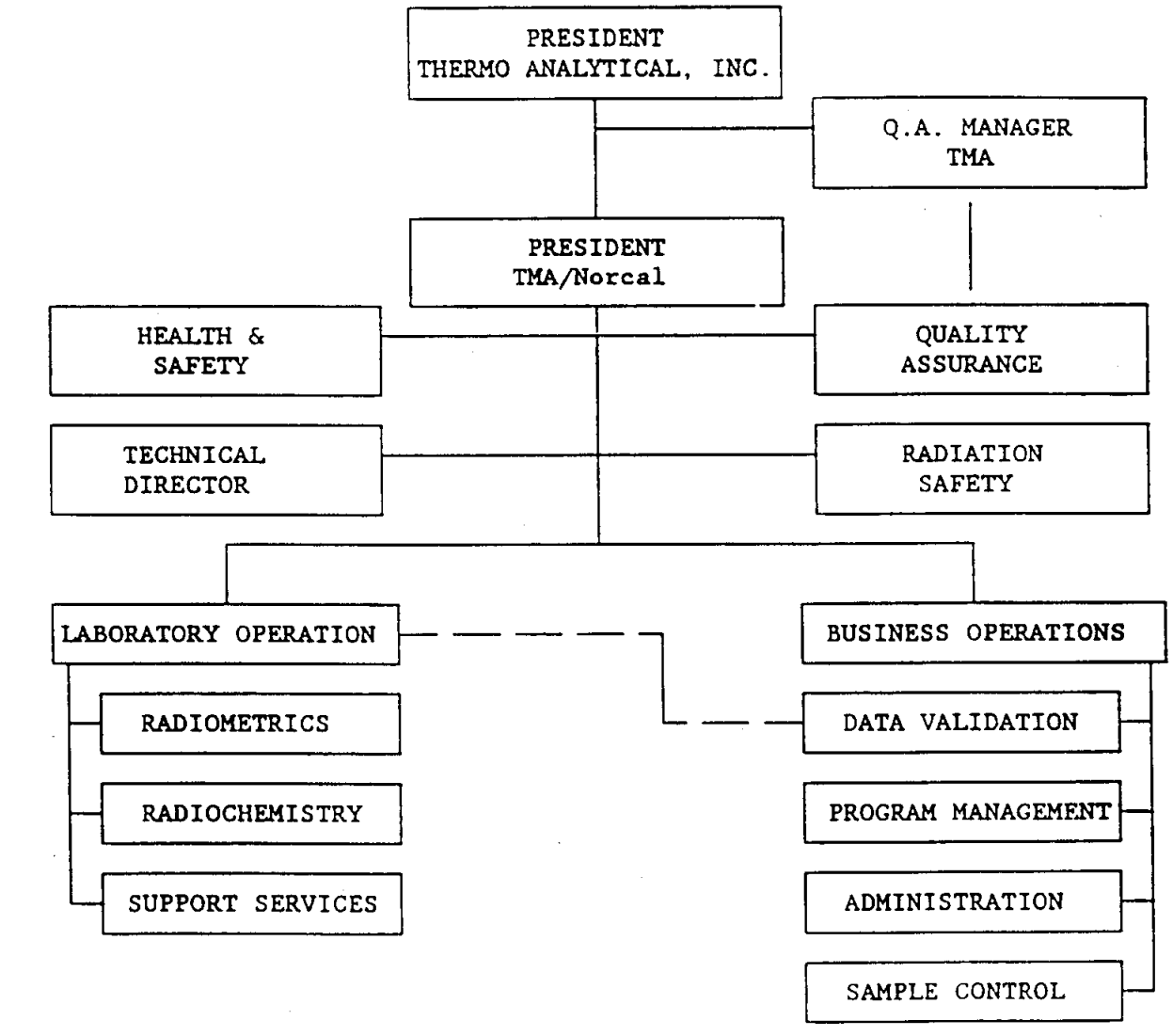
2.3.2 The Quality Assurance Organization is illustrated in Figure 2.

2.3.3 The Laboratory Operations Oganization is illustrated in Figure 3.

FIGURE 1

TMA/Norcal

CORPORATE ORGANIZATION



—— —— = Reporting requirements

FIGURE 2

TMA/Norcal

QUALITY ASSURANCE ORGANIZATION

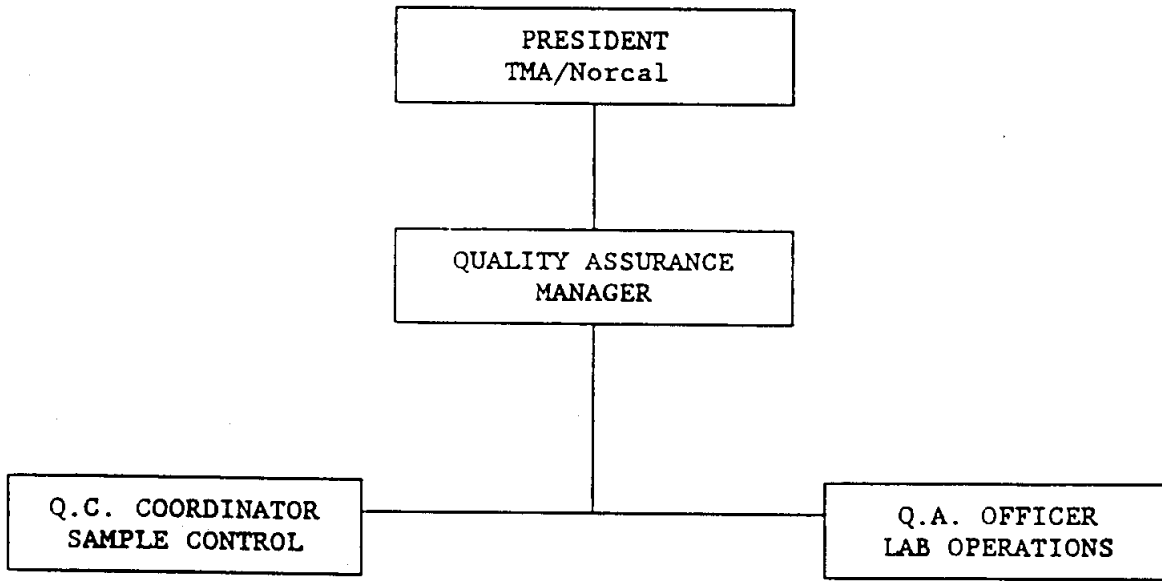
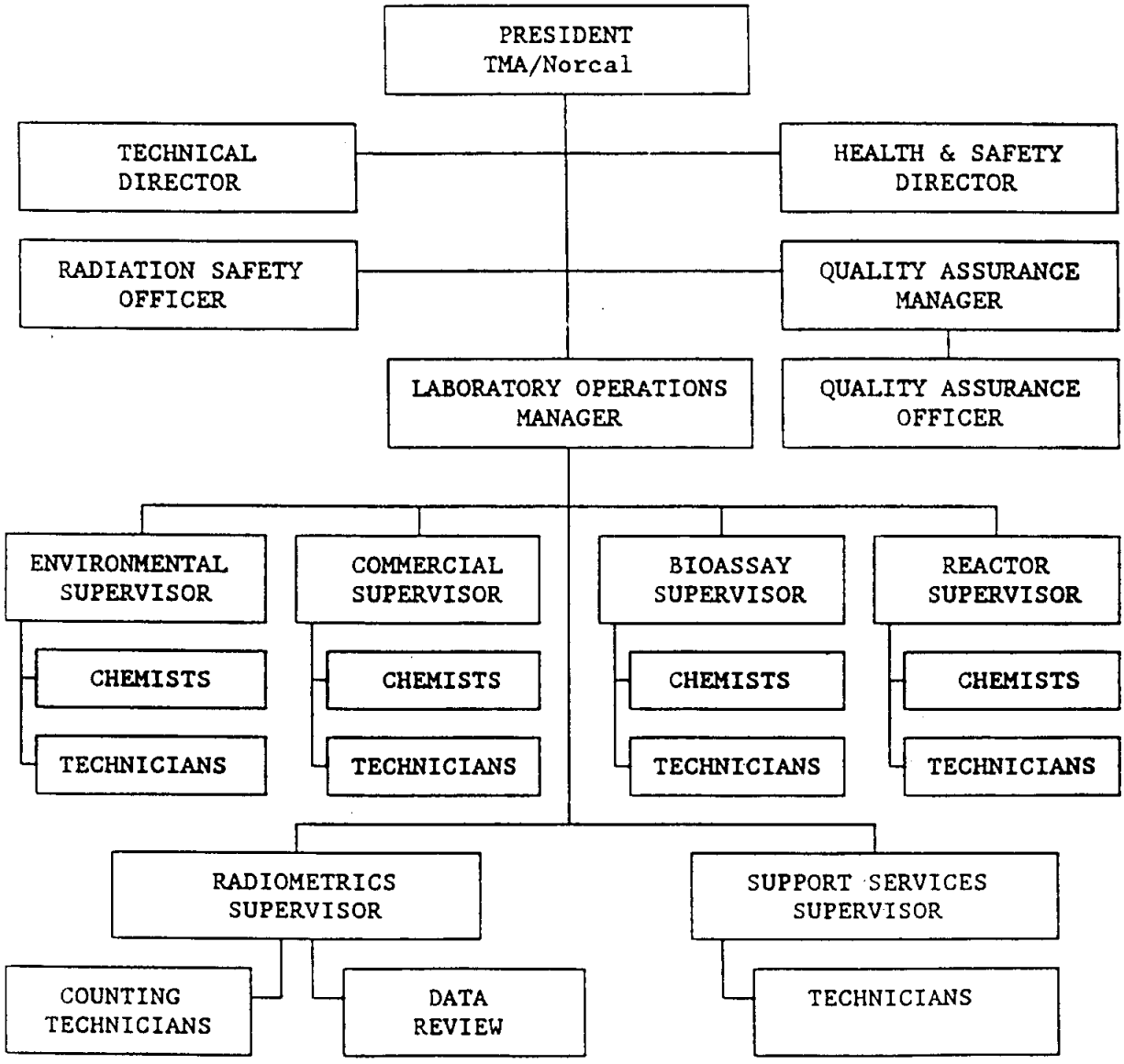


FIGURE 3

TMA/Norcal
LABORATORY OPERATIONS
ORGANIZATION



QUALITY ASSURANCE OBJECTIVES

3.1 OBJECTIVES

The TMA/Norcal Q.A. Program is organized to meet the following objectives:

3.1.1 To provide an effective control for the verification of characteristics of all services that produce data of known quality.

3.1.2 To ensure that services meet the rigid quality and reliability standards of TMA/Norcal including those standards referenced in Section 1.3. Also, to ensure that individual client criteria pursuant to these standards are met.

3.1.3 To provide a continuing monitoring service for review of operating procedures, overall effectiveness and evaluation of the Q.A. Program, and to provide observations and recommendations for improvement in all areas of laboratory operations where quality may be affected. This is achieved by reviewing quality control records of analytical tests being performed seeking data trends and identification of out-of-control situations.

3.1.4 To assure the documents program provides valid records of the control measures applied to all factors bearing on the final results of investigations.

PERSONNEL INDOCTRINATION, TRAINING, AND JOB EVALUATION

4.1 QUALIFIED PERSONNEL

4.1.1 Personnel within TMA/Norcal who perform activities that will affect quality shall have indoctrination, training, and job evaluation conducted on an individual basis to assure that suitable proficiency is achieved and maintained.

4.1.2 Personnel performing technical functions or processes shall have known and documented related work experience and, if required, minimum qualifications of education.

4.2 RESPONSIBILITY

4.2.1 The Supervisors are responsible for initial evaluation of capabilities and qualifications of assigned personnel and shall assign those personnel to perform functions based on the individual's qualifications and abilities.

4.2.2 The Supervisors are responsible for an annual job evaluation of assigned personnel. Documentation of evaluation shall be retained in personnel files.

4.2.3 Appropriate training is the responsibility of the Supervisors with support from management. Training periods will vary according to each job's requirements and previous experience of the employee.

4.2.4 New employees shall receive detailed information concerning Safety Practices, Security Policies, and general Corporate Policies. A current copy of the TMA/Norcal Safety Manual shall be made available to employees who shall familiarize themselves with this document.

4.2.5 Milestone achievements or unique training shall be noted by the Supervisors through entry to the training file. Available certificates of training, education, or awards shall also be maintained in the individual's training file.

4.2.6 The Supervisors shall monitor individual work habits for any needed supportive training. Additional training requirements will be developed by the individual's Supervisor.

4.2.7 Laboratory employees will be informed of the requirements of 10 CFR Part 21 "Reporting of Defects and Non-Compliance," and shall familiarize themselves with this regulation. Familiarization shall be made a matter of record.

4.2.8 Detailed training requirements are outlined in QAP-02 "Personnel Indoctrination, Training, and Job Evaluation."

INSTRUCTIONS AND PROCEDURES

5.1 POLICY

TMA/Norcal's policy is to use written and approved procedures for routine activities and for analytical and operational processes. Applicable procedures are available to laboratory personnel and a current copy of the appropriate procedure is maintained in each laboratory/operations department.

5.2 PROCEDURES

5.2.1 PROCEDURES MANUALS

Procedures Manuals consist of the individual operating procedures for a laboratory area or program combined into one document. The procedures within the manual define all parameters of the operations being performed to include required accuracy and completeness of specific measurement parameters involved.

5.2.2 ANALYTICAL PROCEDURES

Analytical procedures are descriptions of particular protocols for testing. Analytical procedures may be developed when no published reference procedure is the basis for a test and the Laboratory Operations Manager or Q.A. Manager deem it necessary. All procedures shall be incorporated into procedures manuals. Copies of published analytical procedures shall also be included with the controlled copies of Procedures Manuals maintained by the Quality Assurance staff.

5.3 FORMAT AND DISTRIBUTION

5.3.1 All procedures are documented and approved by the relevant Manager or designated cognizant technical personnel and the Q.A. Manager or the Q.A. Officer. Format and guidelines are outlined in QAP-01 "Preparation and Modification of TMA/Norcal Documents."

5.3.2 A copy of each department's Procedures Manual is maintained by the Quality Assurance Staff.

5.4 REVIEW

Procedures/documents shall be reviewed on an annual basis and updated if required.

5.5 REVISION

5.5.1 The appropriate Manager, or designated representative, is responsible for revisions or changes to the applicable Procedures Manuals.

5.5.2 Revisions are reviewed and approved by the organization(s) responsible for the original document. Revisions or changes shall be accomplished on a page replacement basis.

5.5.3 The Q.A. Manager shall be advised of any changes in procedures required to satisfy specifications of the client.

5.5.4 Superseeded procedures, marked "Revised" or "Obsolete" shall be retained by the Quality Assurance staff for five years and then destroyed.

PROCUREMENT DOCUMENT CONTROL

6.1 PURCHASING

Procurement of material, components, supplies, reagents, equipment, and services necessary to carry on the business interests of TMA/Norcal are initiated by purchase requisition and controlled by an authorized TMA/Norcal Purchase Order Number. To the extent necessary, Purchase Orders shall require suppliers to have a Q.A. Program consistent with the requirements of this document.

6.2 PURCHASE REQUISITION REVIEW

Purchase requisitions or change orders are reviewed by the Purchasing Department to assure conformance to the procurement requirements. Quality related requisitions are reviewed by the Q.A. Officer or Q.C. Coordinator prior to being processed.

6.3 CERTIFICATION/CERTIFICATE OF CONFORMANCE

All materials and processes requiring certification and certificates of conformance are identified on the face of the Purchase Order or by attachment thereto. Adequate information is provided to assure vendor compliance to the required specifications. The Q.A. Officer or designated representative is responsible for the retention, filing, and recall of material certification and certificates of conformance.

6.4 SUBCONTRACTS

When subcontracting analytical work TMA/Norcal shall assure, to the extent necessary, that the subcontractor has a Q.A. Program consistent with the requirements of this document. The Q.A. Manager or Q.A. Officer is responsible for evaluation and acceptance of the contractor's or subcontractor's Q.A. Program. Whenever possible, subcontract work shall be performed within the TMA organization.

6.5 VENDORS

6.5.1 For procurement of quality-related items or services the Q.A. Manager and/or the Q.A. Officer are responsible for vendor evaluation and approval. Facility inspection, test reports, or receipt inspections, when the quality of the materials can be verified by these methods, shall be the basis for evaluation. Documentary evidence that products and services conform to procurement requirements shall be provided and retained.

6.5.2 The effectiveness of the control of quality by contractors and subcontractors shall be assessed at intervals consistent with the importance, complexity, and quantity of the product or services.

6.5.3 The Purchasing Department is responsible for maintaining a record of quality related materials received from vendors, including any Rejected Material Reports (RMRs) for non-conforming material.

6.6 QUALITY RELATED SERVICES

The Q.A. Manager or Q.A. Officer shall review the purchase requisitions for quality related services. Those services that are determined to be quality related will include the following statement in the body of the purchase order or by attachment: "The pieces of equipment and/or services to be furnished under this purchase order are subject to the applicable requirements of NQA-1-1989 or MIL-STD 45662A" and "The provisions of 10 CFR Part 21 apply."

MATERIAL RECEIPT AND CONTROL

7.1 POLICY

Only material with acceptable quality characteristics shall be allowed into stock.

7.2 RESPONSIBILITY

Receipt and initial verification of all materials and equipment received by TMA/Norcal, either purchased or contract (client) supplied, is the responsibility of the Receiving and Stock Control Clerk. Technical verification for materials and equipment shall be by the requisitioner, Q.A. Officer, or Q.C. Coordinator, whichever is applicable. Quality related purchase order items will be receipt inspected by the Q.A. Manager, Q.A. Officer, or the Q.C. Coordinator.

7.3 MATERIAL CONTROL

Purchased material is controlled by the Receiving and Stock Control Clerk or designated representative.

7.3.1 The Receiving and Stock Control Clerk is responsible for the expedient and correct routing of all initially accepted received materials to stock, or to the requisitioner.

7.3.2 The Purchasing Department is responsible for maintaining a record of materials received from vendors, including any RMRs for nonconforming material.

7.4 NONCONFORMING MATERIAL

When received material, affecting quality, has been determined to be nonconforming, the requisitioner, Q.A. Officer, or Q.C. Coordinator shall be responsible for initiating the following actions:

7.4.1 Determine if nonconformance requires reporting in accordance with 10 CFR 21 and record on RMR.

7.4.2 Entering the nonconforming inspection data on the RMR and returning the RMR to the Purchasing Department.

7.4.3 Clearly marking the material as a rejected shipment and assuring it is moved to the Receiving Hold Area pending disposition instructions. TMA/Norcal General Purchasing Policies and Procedures Manual specifies disposition of the RMR copies.

7.4.4 The Receiving and Stock Control Clerk is responsible to assure that nonconforming material or supplies are not issued to be utilized in service operations unless specifically approved, in writing, by the client through the Program Manager.

MATERIAL STORAGE AND CONTROL

8.1 POLICY

All materials and supplies in storage shall have the necessary protection to preclude deterioration, corrosion, and damage during storage life and shall carry identification sufficiently clear to assure that only those materials specified by process instructions will be withdrawn from material storage and issued for processing.

8.2 RESPONSIBILITY

Only authorized personnel shall have access to, and the responsibility for, control and issue of materials or supplies. Materials and supplies shall be stored to allow for ready identification. Care shall be taken to preclude mixing of rejected material and supplies with those that are qualified for issue.

CONTROL OF PROCESS

9.1 STANDARD PRACTICES

Standard practices applicable to services provided by TMA/Norcal are contained in documented procedures and this Quality Assurance Manual. Every effort is made to fulfill requirements of the following generic sources of specific practices or factors affecting those practices.

9.1.1 Federal and State rules and regulations.

9.1.2 Consensus standards related to the services performed (e.g., American National Standards).

9.1.3 Regulatory Guides published by the Nuclear Regulatory Commission or Environmental Protection Agency.

9.1.4 Specific contractual agreements with clients.

9.1.5 Where conflict occurs among the above four items, or other appropriate authority, TMA/Norcal shall inform the client and act upon the decision reached by the client and TMA/Norcal.

9.2 DOCUMENTED PROCEDURES

All routine operating procedures are documented. Each procedure includes quality control features which are unique to that process. Routine operating procedures are combined into Procedures Manuals as follows:

9.2.1 SAMPLE CONTROL - Sample Control Procedures (SCP)

9.2.2 PURCHASING

9.2.2.1 General Purchasing Policies and Procedures (PP)

9.2.2.2 Billing Department Procedures (BDP)

9.2.3 DATA VALIDATION - Data Validation Procedures (DVP)

9.2.4 LABORATORY OPERATIONS

9.2.4.1 Radiometrics Instrument Quality Control Manual

9.2.4.2 Radioactivity Measurements Instruments Procedures Manual

9.2.4.3 Environmental Procedures Manual

9.2.4.4 Bioassay Procedures Manual

9.2.4.5 Reactor Procedures Manual

9.2.4.6 Environmental and Reactor Sites Procedures Manual (for Commercial Department)

9.2.4.7 Standardization of Carriers and Tracers Manual

9.2.4.8 Supplementary Quality Assurance Procedures for Nuclear Programs Manual

9.3 RESPONSIBILITY

The Laboratory Operations Manager, or designated representative, determines which instructions or procedures require quantitative or qualitative acceptance criteria and specifies the appropriate criteria on special contracts or projects.

9.4 WORK POLICY

All work to be performed by TMA/Norcal on client samples is authorized by the client through the Program Manager who translates the client's requirements into a SAM system work order for laboratory operations.

9.4.1 The work order specifies those analyses necessary to assure compliance with contractual obligations.

9.4.2 The Program Manager is responsible for notifying the Q.A. Manager and performing laboratory departments, through the appropriate Supervisor, of all contract requirements including reporting and Quality Assurance obligations. This may be done by reference to other documents (e.g. Purchase Order) that contain the contract requirements.

SECTION 10

PREVENTIVE MAINTENANCE

10.1 POLICY

Preventive maintenance is performed as required on instrumentation and equipment to prevent down time and to assure reliable performance.

10.2 MAINTENANCE

Preventive maintenance procedures have been developed for use where procedures are not provided in the manufacturer supplied operator's manual. A record of instrument maintenance, calibration, and repair is maintained. The Supervisors and operating personnel are responsible for complying with the department instrument maintenance schedule.

10.3 SPARE PARTS

Supervisors are responsible to assure that an adequate inventory of spare parts and consumables are requisitioned and maintained for instrumentation in their area in order to prevent downtime or compromised running conditions.

CONTROL OF MEASUREMENT AND TEST EQUIPMENT

11.1 MEASUREMENT AND TEST EQUIPMENT CALIBRATION POLICY

This section establishes the controls and calibration procedures for all analytical measurement equipment.

11.1.1 All equipment, whose operation and function directly affect the quality of service, shall be inspected/calibrated at established intervals. As applicable, equipment shall be suitably identified to reflect calibration status. If an instrument is determined to be out-of-tolerance, it shall be segregated, or otherwise clearly identified as inoperable. Records of each calibration shall be kept in appropriate log books or files.

11.1.2 The equipment used to determine the quality characteristics and accuracy of instruments shall be checked and verified either internally (dependent upon capability), or by qualified calibration vendors.

11.1.3 Frequency of inspection/calibration shall be based on use of the equipment or instrument, environmental conditions in which it is used, its inherent stability, manufacturers recommendation, and the wear or deterioration resulting from its use.

11.1.4 Certified standards are used for all primary calibrations. National Institute of Standards and Technology (NIST) or NIST traceable, Environmental Protection Agency (EPA), and/or Environmental Resource Associates (ERA) standards are used, when available, for the primary calibrations or verification of primary calibrations.

11.1.5 All preparation of solution standards are recorded in a readily accessible logbook. Identities of standards are such that a secondary standard or dilution can be traced, through subsequent actions, back to the initial certification.

11.1.6 Quality Control Check Standards are used to record instrument sensitivity and linearity, and to verify proper response. Methods and calibration entries are dated, initialed, and documented by the analyst.

11.1.7 Measuring and test equipment are tagged as to calibration or operating status for periodic processes performed on a scheduled interval of greater than one month. For processes performed more frequently than this, separate documentation will be available for verification of operational status. Instruments that are too small to be tagged or are subject to a wide variety of calibrations shall have separate documentation of status available.

11.2 RESPONSIBILITY

Testing and calibration of equipment and instruments shall be performed under the direction of the Supervisors or the Laboratory Operations Manager, and performed under suitable environmental conditions.

11.3 PROCEDURES

All tests and calibrations shall be performed in accordance with written procedures which contain provisions for assuring that all prerequisites for the given test have been met, including appropriate equipment to be used.

11.4 CERTIFICATION AND CERTIFICATES OF CALIBRATION

11.4.1 To the extent possible, calibration shall be traceable to NIST. Records of traceability to NIST shall be maintained along with records of routine calibrations of each instrument or measurement system. Where no NIST traceability exists, the basis used for calibration shall be documented.

11.4.2 Equipment records shall be maintained to indicate past and current status, and to provide reproducibility and traceability of results.

11.5 PAST DATA AND REPORTS GENERATED BY DEFICIENT INSTRUMENT

If a major deficiency in an instrument or device is detected during periodic calibration procedures, the technician shall immediately notify the Supervisor, the Laboratory Operations Manager, and the Q.A. Manager. A conference shall immediately be scheduled to investigate and decide what corrective action is to be taken on past data and reports resulting from the use of the deficient instrument or device. The action taken to prevent recurrence shall be documented on a Corrective Action Request form.

DATA REDUCTION, VALIDATION, AND REPORTING

12.1 USE OF COMPUTER HARDWARE AND SOFTWARE

Computer programs used in the production or support of client data shall be developed using approved development methodology. Such programs shall be independently validated, verified, and documented. Changes shall be controlled to assess the potential impact of the change on the performance of the program. Documentation and security shall be in accordance with QAP-12 "Computer Programs and Software Security."

12.2 DATA REDUCTION AND VALIDATION

12.2.1 Results of analyses are generated by computer and are reviewed initially by the Radiometrics staff. The Program Manager performs the final review and approves the data.

12.2.2 Calculation methods, transcriptions and data flow, plus times and locations of the various tiers of review are detailed in the specific procedures manual.

12.3 REPORTING

The Program Manager is responsible for providing the client with the required analytical results. Reports to clients will be reviewed for accuracy and completeness and, where required, analytical methods and minimum/method detection limits (MDL) will be reported. Laboratory reports of analyses shall be signed by the Program Manager, the Technical Director, the Laboratory Operations Manager, or the Data Validation Supervisor who, along with the person who signed the data sheets, can attest to the fact that the data was generated in accordance with established procedures. Hazardous waste analyses reports shall be signed by an authorized designated individual.

DOCUMENT CONTROL

13.1 POLICY

The primary formal communication methods within TMA/Norcal departments are documents that inform or direct activities affecting purchasing, sample analyses, and instrument calibration and/or testing. These documents are controlled by the Q.A. Manual, Operating Procedures Manuals, other documented procedures, or by interoffice memorandums. Drawings and specifications are not controlled as separate documents but are included in controlled procedures as applicable.

13.2 RESPONSIBILITY

13.2.1 The Q.A. Manager is primarily responsible for maintaining files of all controlled documents and shall:

13.2.1.1 Annually review and update the Q.A. Manual.

13.2.1.2 Assure all holders of controlled documents receive copies of changes to the documents.

13.2.1.3 Maintain files of controlled document distribution indicating document title, number, revision number, assigned date, and the name of the individual the document is assigned to.

13.2.1.4 Forward revisions of controlled documents to assigned individuals. An Acknowledgement Form shall accompany each document revision for verification of receipt and to provide disposition instructions for the superseded pages.

13.2.2 Uncontrolled copies of controlled documents shall be distributed only if marked "Uncontrolled."

13.2.3 Obsolete documents are isolated from use or destroyed.

INTERNAL QUALITY CONTROL

14.1 LABORATORY OPERATIONS

Precautions are taken in the laboratories to avoid cross-contamination of samples and to assure the reporting of accurate results. Quality control samples are analyzed along with routine samples to indicate when results may be in error due to improper operation or calibration of equipment, inadequate training of personnel, a deficiency in the procedure, or cross-contamination from other samples.

14.1.1 LABORATORY PRECISION

The Laboratory Operations Manager is responsible to assure that analytical results are reproduced internally within acceptable limits.

14.1.2 STANDARDS, TRACERS, AND CARRIERS

The Q.A. Officer is responsible for the production and submission of tracers and carrier stocks used in the analysis of customer samples. Standards that have been certified by NIST or standards that have been obtained from suppliers who participate in measurement assurance activities with NIST are used when such standards are available. Procedures to be followed in the production of standards, tracers, and carriers are detailed in the "Standardization of Carriers and Tracers Manual."

14.1.3 CALIBRATION AND PERFORMANCE CHECKS OF RADIATION MEASUREMENT SYSTEMS

Reference standards are used for calibrating radiation measurement systems. In addition to calibration of all instrumentation, performance checks are made to assure the continuing integrity of the instrument performance. These procedures include efficiency checks, background determinations, and energy calibrations. The procedure and

frequency of each check is optimized for each detector system to provide assurance of the detectors performance. Documentation of the checks and the results are kept for all procedures. The Radiometrics Supervisor is responsible for these calibration and performance checks. Detailed procedures and schedules are outlined in the "Radiometrics Instrument Quality Control Manual."

14.1.4 INTRALABORATORY ANALYSIS OF QUALITY CONTROL SAMPLES

14.1.4.1 Spiked and blank samples are submitted by the Q.A. Officer to the chemistry groups for analysis to provide an intralaboratory basis for estimating the accuracy of the analytical results. Spiked samples are prepared from standardized solutions, when available. The minimum percentage of spikes and blanks is determined by the Program Manager based on program requirements.

14.1.4.2 Replicate samples, usually duplicates, are analyzed whenever practicable. The minimum percentage of replicate samples is determined by the Program Manager based on program requirements.

14.1.4.3 The Q.A. Officer may submit Q.C. samples, in addition to those required by the project, should they be deemed necessary.

14.1.5 COLLABORATIVE TESTING

In addition to the internal quality control samples described above, the laboratory shall participate in collaborative testing or interlaboratory comparison programs. Natural or synthetic samples carefully prepared

to contain known concentrations of the nuclides are sent to participating laboratories by an independent referee group such as the Nuclear Radiation Assessment Division of the U.S. Environmental Protection Agency at Las Vegas, Nevada. After statistically comparing the resulting data from triplicate analyses of the special standard sample, the degree of analytical validity of the results is reported and updated performance information is returned to each participant. The program thus enables each laboratory to document the precision and accuracy of radioactivity measurements, identify instrumental and procedural problems, and compare performance with other laboratories.

14.1.6 COMPUTATIONAL CHECKS

14.1.6.1 A substantial number of the results of manual calculations for the computation of the concentration of radioactive materials are checked by another equally qualified person.

14.1.6.2 All computer programs are documented using ANSI N413-1974 as a guideline. Detailed procedures for documentation and verification of computer programs are included in QAP-12 "Computer Programs and Software Security."

14.1.7 REVIEW AND ANALYSIS OF DATA

The review and analysis of data from sample planchets submitted to Radiometrics for counting are performed on a timely basis by the Radiometrics staff. Program Managers perform the final review of data before it is released to the customers. Instructions are detailed in the Data Review Requirements of the "Radioactivity Measurements Instrument Procedures Manual."

14.2 DATA VERIFICATION

Routine performance requires inclusion of all pertinent information with basic documents dated and initialed or signed. The work order has recorded such information as the identity of the samples and analyses to be performed. All raw data and other information used in performing the analyses is documented.

14.2.1 ELECTRONIC DELIVERABLES VERIFICATION

The Program Managers are responsible for assuring that electronic deliverables are complete and accurate.

14.3 SAMPLE CUSTODY

All samples are assigned a unique laboratory identification number, marked directly on the container, which identifies the work order set number and the sample number. The laboratory has a designated sample custodian and a back-up sample custodian for strict (legally defensible) chain-of-custody samples. Locked refrigerators, freezers, and cabinets are available for strict chain-of-custody samples. Sample custody forms are used for tracking all samples through the analytical process. Details for radiological survey of samples, sample security, sample disposal, etc. are outlined in the Sample Control Procedures Manual. Sample chemistry requirements are designated by a Group Number that is assigned by the Program Manager after consultation with the Laboratory Operations Manager if necessary.

AUDITS

15.1 POLICY

TMA/Norcal has established a comprehensive system of planned and documented audits to verify compliance with all aspects of the Q.A. Program. An audit is defined as a documented activity performed in accordance with written procedures or checklists to verify, by examination and evaluation of objective evidence, that applicable elements of the Q.A. Program have been developed and effectively implemented in accordance with specific requirements. Audits shall be performed by persons not having direct responsibility for the areas being audited.

15.1.1 CUSTOMER ACCESS TO TMA/NORCAL FACILITIES AND PERSONNEL

The client is frequently responsible for auditing TMA/Norcal's performance relative to regulatory requirements. The exact nature of this responsibility is relative to the nature of the regulatory or licensing requirements, the significance of the services, and the technical expertise available or inherent within the client's organization. The need for, and frequency of, client audits is dependent upon the above factors. A client may authorize an independent agency to perform an audit on his behalf. When possible, TMA/Norcal will make available for client inspection its equipment, records (proprietary information excluded), and facilities, along with the necessary personnel to permit verification of quality characteristics.

15.1.1.1 The Q.A. Manager shall coordinate and participate in audits conducted by the client or representative.

15.1.2 INTERNAL AUDITS

TMA/Norcal shall audit its own facilities to verify compliance with established procedures and requirements set forth in the Q.A. Manual. Use of a check list will insure items in compliance are noted as well as any requirements for improvement.

15.1.3 EXTERNAL AUDITS

External audits of organizations providing services to TMA/Norcal are scheduled at a frequency commensurate with the status and importance of the activity.

15.2 RESPONSIBILITY

Audits shall be directed by the Q.A. Manager with assistance from the Q.A. Officer, Q.C. Coordinator, and Operations Managers.

15.2.1 The Q.A. Manager shall be responsible for an independent quality assurance audit of each department.

15.2.2 The Q.A. Manager shall be responsible for assuring that audits are performed by knowledgeable professionals.

15.2.3 An independent qualified auditor shall audit areas of responsibility assigned to the Q.A. Manager.

15.2.4 The individual assigned the responsibility of conducting an audit shall be certified to ASME NQA-1-1989 requirements.

15.3 DOCUMENTATION

Audit results, along with recommendations for corrective action, shall be documented by the Q.A. Manager.

15.3.1 The President, TMA/Norcal, the appropriate Manager, and the Q.A. Officer shall be provided with a copy of the Audit Report.

15.3.2 Recepients shall review the audit report to determine responsibility and any corrective actions required.

15.4 DEFICIENT AREAS

Deficiencies shall be corrected by the person designated in the audit report as responsible for the corrective action.

15.4.1 The Q.A. Manager shall verify that action has been taken to correct any deficiency and shall verify, during the next audit, that corrections have been completed.

15.5 FREQUENCY OF AUDITS

The Q.A. Manager shall conduct internal audits on an annual basis. Additional selective audits shall be conducted when one or more of the following conditions exists:

15.5.1 When significant changes are made in functional areas of the Q.A. Program, including significant reorganization and procedure revisions.

15.5.2 When assessment of a Program's effectiveness is considered necessary.

SECTION 16

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QUALITY ASSURANCE AND INSPECTION RECORDS

16.1 POLICY

Records that provide objective evidence of the quality of work and of associated activities conducted in all phases of project work or consulting services are generated and maintained. These records include sample analyses data sheets, the results of reviews, inspections, tests, audits, corrective actions, and reports. Also included are related data such as personnel qualifications, procedures, and equipment records.

16.2 RESPONSIBILITY

Responsibility for initiation, completeness, and reliability of Quality Assurance Records is vested in the appropriate Manager with periodic verification checks by the Q.A. Officer or Q.C. Coordinator. All company personnel performing processes or services for which controlling documentation is an associated part of the work being performed shall assist in the efforts.

16.3 RECORDS

16.3.1 Inspection and test records shall, as a minimum, identify the Inspector or Data Recorder, the type of observation, the results, the action taken in connection with any deficiencies noted, and the date of the inspection or test.

16.3.2 All required records shall be legible and of a quality that can be copied. Records shall be completed using reproducible ink. Errors or incorrect entries, shall be lined through with a single line, dated, and initialed by the recorder.

16.3.3 Correspondence from clients may be available for inspection at the discretion of TMA/Norcal and authorization from the originating organization.

16.3.4 Quality Assurance records shall be identified and controlled by customer number and/or client identification as applicable.

16.4 STORAGE OF RECORDS

16.4.1 Quality Assurance records shall be properly stored and may be made available to the client upon request.

16.4.2 Records shall be maintained in a secured and protective storage area.

16.4.3 Records shall be identified so as to be retrievable at a later date.

16.4.4 Chain of custody records are included with the sample set records.

16.4.5 Specific arrangements shall be made by the client for longer retention of records or for duplication of records to be stored by the client.

16.4.6 The Q.A. Manager, Q.A. Officer, Q.C. Coordinator, or Laboratory Operations Manager shall be responsible for governing access to, and control of these records.

16.4.7 Quality Assurance records are maintained and stored in accordance with QAP-04 "Storage and Retrival of Quality Assurance Records."

CORRECTIVE ACTION

17.1 POLICY

TMA/Norcal's policy is to assure continuous acceptable quality levels for services provided. The Corrective Action Request system has been established to assure that conditions adverse to quality are promptly identified and corrected.

17.2 CORRECTIVE ACTION REQUEST (CAR)

The Q.A. Manager or Q.A. Officer shall initiate investigation and corrective action by issuing a CAR in any of the following situations:

17.2.1 When an audit reveals circumstances that may adversely affect quality as determined by the Q.A. Manager.

17.2.2 When the results of an intercomparison study program are out of control.

17.2.3 When procedural or technical problems arise and the Q.A. Manager determines that they may significantly affect quality.

17.3 RESPONSIBILITY

All laboratory personnel are responsible to communicate any evidence of unacceptable quality performance to their supervisor, the appropriate Manager, and the Q.A. Manager.

17.3.1 The appropriate Manager, or designee, shall be responsible for investigating conditions adverse to quality, determining the assignable root cause, and recommending the actions necessary for their correction.

17.3.2 The appropriate Manager, or designee, shall initiate action to correct the root cause of the adverse conditions and then determine and initiate the specific corrective actions necessary to preclude recurrence.

17.3.3 The Q.A. Manager shall review CARs and other routine Quality Control reports for evidence of unacceptable quality.

17.3.4 All items requiring corrective action shall be clearly identified on the CAR Form for subsequent follow-up and close out actions. Completed copies of the CARs shall be kept on file by the Quality Assurance Staff.

QUALITY ASSURANCE REPORTS TO MANAGEMENT

18.1 POLICY

TMA/Norcal's policy is to keep management appraised of all quality assurance problems, actions taken to correct them, and any actions taken to prevent recurrence.

18.2 QUALITY CONTROL REPORTS

The Q.A. Officer and Q.C. Coordinator shall, on a monthly basis, summarize all quality control activities and provide a report to the Q.A. Manager.

18.3 QUALITY ASSURANCE REPORTS

18.3.1 The Q.A. Manager shall provide the President, TMA/Norcal, and the TMA Corporate Q.A. Program Manager with a monthly report detailing the laboratory's quality control activities and performance summaries.

18.3.2 Special reports to the President, TMA/Norcal, will be provided whenever results of intercomparison studies or tests are received and whenever CARs are initiated.

18.3.3 The Q.A. Manager shall also report to the President, TMA/Norcal, general or system audit results, problems, corrective actions, and replies.

APPENDIX C

TMA/NORCAL RADIOCHEMISTRY PROCEDURES FOR TRITIUM ANALYSIS OF SOLIDS

1.0 Introduction

This procedure extracts aqueous tritium from vegetation by azeotropic distillation with toluene. The tritium activity is then determined by LSC.

2.0 References

TMA/Norcal Safety Manual
TMA/Norcal Sample Control Procedures
TMA/Norcal Health Physics Manual
TMA/Norcal Q.A. Manual
For specific material information refer to the appropriate MSDS.

3.0 Responsibility

3.1 The Supervisor has the responsibility to ensure that the analyst (Chemist or Technician) has been properly trained in the following procedure and that the analyst is aware of any hazards pertaining to the following procedure. Also the Supervisor must ensure that the equipment and facilities needed by the analyst to successfully complete the following procedure are available.

3.2 The analyst has the responsibility to follow sections 6.1, 6.2, and 6.3 fully, and to use professional judgement to evaluate the success of the procedure at each step. The analyst must also process any Q.C. samples associated with the group being analyzed, and coordinate with the lab Supervisor if any work must be completed by another shift.

4.0 Safety

4.1 The analyst shall be versed in the TMA/Norcal Safety Manual before engaging in radiochemical procedures, and know how to handle an emergency should one arise. For questions regarding proper handling procedures of chemicals refer to the TMA/Norcal Safety Manual or the appropriate MSDS, or contact the Lab Supervisor.

4.2 All reagents, unless otherwise specified, should be considered as contact and inhalation hazards. Wear protective gloves and use fume hoods.

4.3 Toluene is a contact and inhalation hazard and is highly flammable. Use in a fume hood and wear gloves and eye protection when in use. Do not combine with strong oxidizing agents or acids.

Approved:

11-5-92 [signature] K. Yamamoto

Date Cognizant Technical Personnel for Quality Assurance Manager

5.0 Materials / Reagents

Materials	Reagents
Allihn condenser, S/T 24/40	Toluene
Distillation flask, S/T 24/40 round bottom, 250 mL	Picofluor LLT Cocktail
Distillation receiver, S/T 24/40 #3642	
Heating mantle	
Centrifuge tube, 40 mL	
Transfer pipet	
Bittner bulb	
Glass scintillation vial, 25 mL	

Verify that all reagents to be used have an expiration date label on their containers and that the expiration date has not been exceeded. See QA procedure QAP-06 for details.

6.0 Procedure

6.1 Preparation

Before starting the analysis have all materials and reagents at hand. Be sure you have allowed enough time to complete the analysis. Verify that the sample planchets have been created in the computer database. If the planchet must be counted promptly upon completion of the analysis then coordinate with the counting room before the analysis is started.

6.2 Sample procedure

1. Hydrogen-3 in samples may be determined on a sample weight basis or on a volume of distillate basis. If analysis is on a wet weight basis, transfer aliquot to a distillation flask and record the received weight. (Note a) If analysis is on a water volume basis, simply transfer a suitable quantity of sample to the distillation flask. (Note b) Add ~100 mL of toluene.

    a. Some samples, such as grains, may require grinding before analysis.

    b. The percentage of H_2O can vary from 10-90%. The client may also require percent moisture to be reported. In this case record the sample wet weight aliquot.

2. Connect the flask containing the sample to the distillation receiver. Connect receiver to a proper Allihn condenser. Place the unit on a heating mantle. Slowly heat the sample and avoid bumping. Adjust the temperature so that condensation is observed in the condenser above the receiver.

3. If the analysis is to be recorded on a weight basis, reflux until no more H_2O is observed in the receiver, and record the total volume of H_2O. If the analysis is on a volume basis, reflux until 10 mL of H_2O have been collected.

4. Remove the receiver and transfer 10.0 g of distillate to a plastic scintillation vial. Add 10 mL of Picofluor cocktail.

5. Shake the sample until it is homogeneous, label the cap of the vial, and turn in with a Log-in form to Radiometrics for counting.

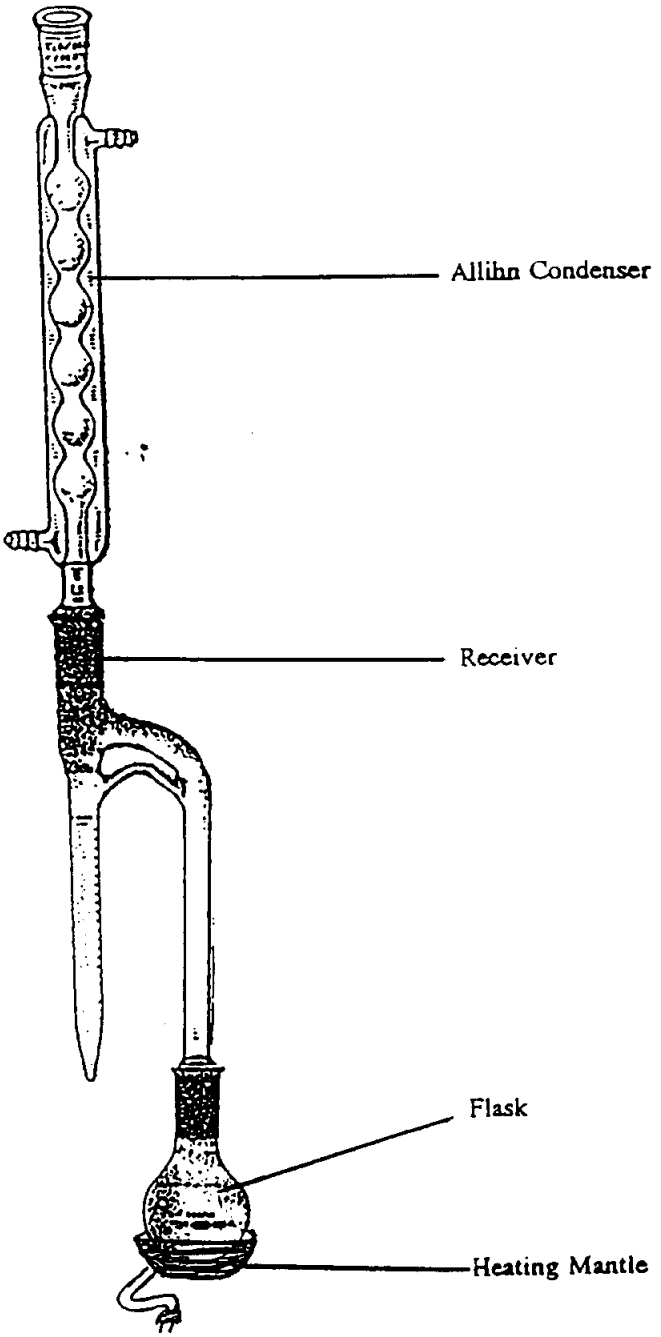
6. Process a blank with each batch of samples. Add 20 mL H_2O and ~100 mL Toluene to a flask and continue with Step 2.

6.3 Waste Disposal

For disposal of other wastes generated in this procedure see EP-010.

7.0 Supersession / Recision

This procedure supersedes TMA/Norcal EA-48, rev. 4 "Aqueous ^3H in Vegetation (Azeotropic Distillation)", of July 1991.



Azeotropic Distillation Assembly